NAVY
PROPOSAL SUBMISSION

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Navy SBIR Program Manager is Mr. Vincent D. Schaper ((703) 696-8528). The Deputy SBIR Program Manager is Mr. John Williams ((703) 696-0342). Inquiries of a general nature may be brought to the Navy SBIR Program Office's attention and should be addressed to:

Office of Naval Research
ATTN: NAVY SBIR PROGRAM, CODE 362
800 North Quincy Street, RM 633
Arlington, VA 22217-5660

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy, primarily through topics which address the Navy Science and Technologies areas and have dual-use potential. A total of 33 Science and Technology (S&T) areas (listed in table 1) have been identified. Navy topics will be funded from these areas according to a priority it has established to meet its mission goals and responsibilities. Additional information on the Navy and Navy SBIR Program can be found on the ONR Home Page (http://www.onr.navy.mil)

PROPOSAL SUBMISSION:

There are two ways to submit your SBIR proposal to the Navy. The Navy WILL NOT accept the Red Forms in the rear of this book as valid proposal submission forms of the Appendix A and B. Instead proposers must use **one** of the following procedures **(but not both)**:

1. Online Submission (through the Internet)

A. Go to the ONR Homepage (address --http://www.onr.navy.mil), click on "Business Opportunities", then click on "Navy SBIR Online Submission Interface".
B. Submit your Appendix A and B via the Online Submission option. Make sure that you follow instructions to complete the electronic transfer of the appendices.
C. Print out and sign the Appendix A and B form.
D. Submit the signed Appendix A and B form along with one original and four copies of your entire proposal (including 4 copies of the signed Appendix A & B form) to the Navy SBIR Program Office at the above address. Mark the outside of the envelope with your topic number.

2. Diskette submission

A. Obtain the Navy SBIR Appendix A and B program (Sbir_ab.exe). This program is available from the Navy SBIR Bulletin Board (through the Internet) or you can request a copy of it on disk from the above address (please specify the computer platform PC or Mac).
B. To download this program from the Internet: go to the ONR Homepage (address --http://www.onr.navy.mil), click on "Business Opportunities", click on "Navy SBIR/STTR Bulletin Board", click on "Electronic Data Entry Forms". Click on "SBIR" under the heading for "Proposal cover sheets: Appendix A and Appendix B" or scroll down to the "For Macintosh Users" section for Mac versions.

C. To run the program, double-click on it in File Manager (in Windows 3.1) or Windows Explorer (in Windows '95), or for Mac versions, open it in your spreadsheet application.
D. Data enter information.
E. Save file with .dat extension.(Do not save in a word processing format)
F. Print out and sign the Appendix A and B form.
G. Submit the signed Appendix A and B form along with one original and four copies of your entire proposal (including 4 copies of the signed Appendix A & B form) together with a disk containing the .dat file generated from the Appendix A and B program to the Navy SBIR Program Office at the above address. (Please note we do not want the entire proposal text on disk, just the Appendix A and B.) Mark the outside of the envelope with your topic number.

ABOUT THE NAVY SUBMISSION AND THIS SOLICITATION:

This solicitation contains a mix of topics. When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Be sure that you clearly identify the topic your proposal is addressing. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of a successful Phase I effort will be eligible to participate for a Phase II award. If you have been invited to submit a Phase II proposal to the Navy by the TPOC, obtain a copy of the Phase II instructions from the Navy SBIR Bulletin Board on the Internet or request the instructions from the Navy SBIR Program Office. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office (at the above address) for proper processing. If the Program Office is unaware of the proposals in the system, they can not be tracked. Phase III efforts should also be reported to the SBIR program office noted above.

The Navy will provide potential awardees the opportunity to reduce the gap between Phases I and II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. The Navy will not accept Phase I proposals in excess of $70,000 (exclusive of the Phase I option). The technical period of performance for the Phase I should be 6 months and for the Phase I option should be 3 months. The Phase I Option should be the initiation of the next phase of the SBIR project (i.e. initial part of Phase II). The Navy will also offer a "fast track" into Phase II to those companies that successfully obtain third party cash partnership funds ("fast track" is described in Section 4.5 of this solicitation). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 maximum demonstration phase of the SBIR project (i.e. Phase II); 2) a transition or marketing plan (formally called a "commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan for further R&D if the transition plan is evaluated as being successful. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II Option will be limited to 40 pages (unless otherwise directed by the TPOC or contract). The transition plan should be in a separate document.

The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY AREAS	SCIENCE AREAS

Aerospace Propulsion and Power
Aerospace Vehicles
Battlespace Environment
Chemical and Biological Defense
Clothing, Textiles and Food
Command, Control and Communications
Computers, Software
Conventional Weapons
Electron Devices
Electronic Warfare
Environmental Quality and Civil Engineering
Human-System Interfaces
Manpower, Personnel and Training Systems
Manufacturing Technology
Materials, Processes and Structures
Medical
Sensors
Surface/Undersurface Vehicles/Ground Vehicles
Modeling and Simulation

Atmospheric and Space Science
Biology and Medicine
Chemistry
Cognitive and Neural
Computer Sciences
Electronics
Environmental Science
Manufacturing Science
Materials
Mathematics
Mechanics
Ocean Science
Physics
Terrestrial Sciences

NAVY TOPIC TITLES

OFFICE of NAVAL RESEARCH

N97-100 TITLE: Group III Nitride Bulk Crystals

N97-101 TITLE: Integrated Cooling Planes in Vertically Arrayed High Temperature Superconducting Device Circuits

N97-102 TITLE: High-Power Mid-Infrared Diode Laser

N97-103 TITLE: Advanced Antenna Concepts

N97-104 TITLE: Four-Dimensional (4-D) Atmospheric and Oceanographic Instrumentation

N97-105 TITLE: MCM Technologies for Detection, Classification, and Identification/Localization of Sea Mines and Submarines

N97-106 TITLE: Underwater Acoustic Communications Channel and Network Optimization

N97-107 TITLE: Light-Weight Satellite Sensors for Space Environment Sensing

N97-108 TITLE: Growth of Single Crystal Piezoelectrics

N97-109 TITLE: Miniature Diode Laser Velocity Sensor

N97-110 TITLE: Ultrasonic Diagnostic Imaging Transducers for Combat Casualty Care

N97-111 TITLE: Self Assembled Monolayer Based Methods for Materials Processing and Device Fabrication

N97-112 TITLE: Computer-based Training for Adult Literacy Enhancement

N97-113 TITLE: Detection and Tracking of Human Combatants by an Unattended Video Surveillance Device in Urban Environments

N97-114 TITLE: Biologically Motivated Neural Processing Architectures for Multi-Spectral Fusion

N97-115 TITLE: Remotely Operated Undersea Vehicle (ROV) Pilot Training System

N97-116 TITLE: Hard Target Penetrator End-Game Guidance

N97-117 TITLE: Virtual Laser - Kinematic Global Positioning System (GPS) Terminal Guidance from Spotter to Projectile

N97-118 TITLE: Terminal Guidance for Mid-Caliber Naval Guns

N97-119 TITLE: Thermographic Technology Development for Real-Time Fault Detection

N97-120 TITLE: Intelligent Control Algorithms and PC-Based Software Tool Development for Multiple Effector Control Systems

N97-121 TITLE: Biologically Inspired Processor for All-Source Data Association and Fusion

N97-122 TITLE: Affordability Measurement and Prediction Technologies

N97-123 TITLE: Large Area Infrared Emissivity Controlled Surfaces

N97-124 TITLE: Vapor Phase Corrosion Inhibitors

N97-125 TITLE: 3D Virtual Workbench

N97-126 TITLE: Structural Health Monitoring Using Fiber-Optic Sensing

MARINE CORP SYSTEMS COMMAND

N97-127 TITLE: AAAV Surf Zone Simulation Model

N97-128 Canceled

N97-129 Canceled

N97-130 TITLE: Commercial Digital Camera Environmental Protection

N97-131 TITLE: Wide-Field-Of-View Anamorphic Lens

NAVAL AVIATION TEAM

N97-132 TITLE: Utilization of Fractal Based Models for Acoustic Signal Processing

N97-133 TITLE: COTS Real Time Unified Avionics Interconnect

N97-134 TITLE: Low-cost High-speed Optical Links for Advanced Avionics Data Networks

N97-135 TITLE: Advanced Ship Motion Forecasting for Expanded Aviation Operations

N97-136 TITLE: Advanced Targeting through Decision Aids

N97-137 Canceled

N97-138 TITLE: Interference Mitigation in Night Vision Goggle (NVG) Systems

N97-139 TITLE: Advanced signal processing and Display Concepts for airborne Active ASW Systems

NAVAL FACILITIES ENGINEERING CENTER

N97-140 TITLE: Rapid Cargo Throughput for Sea Based Logistics

N97-141 TITLE: Relocatable Crane Technology for Use on Floating Platforms

N97-142 TITLE: Integrated Control of A Powered Causeway Ferry

N97-143 TITLE: Multiple Access RF Communication Protocol

N97-144 TITLE: Inflatable Boat Propulsion System

N97-145 TITLE: Tactical Tracking and Inventory System

NAVAL SUPPLY SYSTEMS COMMAND

N97-146 TITLE: Environmentally-Safe, Disposable Food Service Utensils

BUREAU of NAVAL PERSONNEL

N97-147 TITLE: A Tool to Optimize the Predictive Accuracy of Personnel Selection and Classification Instruments

N97-148 TITLE: Diagnostic Cognitive Task Analysis of Team and Multi-team Training

N97-149 TITLE: Diagnostic Tool for Reengineering Team Training Using Cognitive and Team Process Analyses

SPACE and NAVAL WARFARE SYSTEMS COMMAND

N97-150 TITLE: Target Imagery Classification System

N97-151 TITLE: Interactive Audio Human System Interface

N97-152 TITLE: Wide Range Tunable Filter

N97-153 TITLE: Security for Reprogrammable Electronic Devices

N97-154 TITLE: Transmission of Critical Aircraft Flight/Emergency Data via JTIDS/MIDS (Lx Band)

N97-155 TITLE: High Energy Density Battery

N97-156 TITLE: Application of Standard Network Technologies to Surveillance Arrays

N97-157 TITLE: Code Analysis Tools for High Integrity Systems

N97-158 TITLE: Detection using a Generalized Hough Transform Track- Before- Detect Processing of Split Horizontal Line Array Cross-Correlations

N97-159 TITLE: Generic Multiple Access Module Prototype for the PRIDE (Programmable Intelligent Digital Electronics) System

N97-160 TITLE: Broadband Signature Information Identification and Extraction

N97-161 TITLE: Shipboard Auto-Tracking with a Stabilized Platform

N97-162 TITLE: Physics-Based Signal Processing Techniques For Next Generation Naval Systems

N97-163 TITLE: High Performance Elastrometric Boot materials for Advanced Low Frequency Sonar Projector Applications

N97-164 TITLE: Reengineering of Distributed Source Code

NAVY SBIR PROGRAM MANAGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT	PHONE
100 - 126	Mr. Douglas Harry	703-696-4286
127 - 131	Mr. Joe Johnson	703-784-4801
132 - 139	Ms. Carol Van Wyk	301-342-0215
140 - 145	Mr. Andy Del Collo	703-325-8533
146	Mr. Dennis Gaddis	717-790-7435
147 - 149	Dr. Frank Vicino	619-553-7612
150 - 164	Ms. Linda Whittington	703-602-1031

DEPARTMENT OF THE NAVY
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SUBJECT/WORD INDEX

OFFICE of NAVAL RESEARCH

N97-100 TITLE: Group III Nitride Bulk Crystals

OBJECTIVE: To demonstrate growth technology for commercially viable semiconductor grade gallium nitride, indium nitride or aluminum nitride bulk crystals.

DESCRIPTION: The Navy has identified future requirements for Ultraviolet Detectors, radiation-hard high-voltage solar cells and solar blind detectors. These devices will be fabricated from epitaxial aluminum and gallium nitride and their alloy semiconductor epitaxial films. Suitable substrates for these epitaxial films are not yet commercially available and techniques for their optimized commercial production not yet defined. Growth rates in excess of 500 micrometers per hour, and crystal diameters in excess of 1" are considered essential. An additional need is for high purity, oxygen free polycrystalline, powder or amorphous group III nitride source materials for bulk growth. Proposals are requested for investigative research directed toward commercial production of 25 to 50 mm and larger diameter semiconductor grade GaN, AlN, and InN bulk single crystals. Special attention will be paid to proposals addressing flux growth from liquid metallic phases. It is expected that proposals will address time-scales, estimated substrate pricing, anticipated boule dimensions and production capability. Techniques that utilize non nitride substrates and seeds or that cannot approach growth rates of 1 millimeter per hour or higher will be considered non-responsive.

PHASE I: Contractor will develop technology concept for preparation of single crystal bulk GaN, AlN, InN, or alloys such as AlGaN. Target boule diameters and lengths in the first phase would be 25 mm and 100mm respectively, with extended defect densities below 10^7 cm^{-3}. Phase 1 study should identify technology to enable 50 mm diameter boules to be attempted in phase II. full technical report would be deliverable at end phase 1.

PHASE II: Proof of concept by demonstration of growth rates of 1 millimeter per hour or higher. Contractor will develop production scale technology for single crystal nitrides, and develop technology for production scale growth larger size boules. Target diameters and lengths are >50mm and 200mm respectively, with extended defect densities below $10^6 cm^{-3}$. Feasibility of much higher growth rates are also desirable. Contractor should address cutting and polishing approaches in phase I and demonstrate capability in phase II.

PHASE III: Contractor will transition bulk nitride growth and "wafering capability to commercial operation. Contractor should also supply bulk nitride crystals to DoD laboratories and contractor/grantees for characterization and evaluation of semiconductor/defect quality.

COMMERCIAL POTENTIAL: The commercial and military market for blue LED and laser diodes for display, data storage, and optical communications, is predicted to exceed $2B in 2001. The Navy and DoD need solar blind UV detectors for missile threat detection. Currently, although good detectivities are demonstrated, however substrate associated defects in devices on heteroepitaxial films, limit recovery speed and operational frequency. Applications in high power microwave communications are also limited by electrically active foreign substrate related defects.

N97-101 TITLE: Integrated Cooling Planes in Vertically Arrayed High Temperature Superconducting Device Circuits

OBJECTIVE: To develop a system for providing uniform cooling to temperatures of the order of 77K for a rigidly bonded, vertically arrayed set of substrates that have patterned circuits of high temperature superconductor (HTS) on them.

DESCRIPTION: HTS circuits will deliver greater performance advantages in electronics applications if they can be packaged into rigid vertical stacks which minimize the volume required, provide immunity to vibration related detuning of the circuits, and maximize the performance gain allowed by their low power consumption. Both commercial and military applications in wireless communications and high speed computing and signal processing favor operation relatively close to the material's transition temperature where the electrical properties are a strong function of their temperature. This will assure that entire vertical stacks of operating chips have a uniform and repeatable temperature distribution is highly desirable. The number of channels provided per base station and the sensitivity of the receiver are both increased by the improved filters which HTS has been demonstrated to provide, especially for the US assignment of carrier frequencies and in satellite operations. Provisions for electrical connection to any layer, preservation of the quality of the HTS material, and small contribution to microwave dissipation are required. Low loss rf leads must be provided between the planes and methods to control losses due to fringing fields from the circuit interacting with the cooling plane devised. Proof of concept experimental demonstration must be included using either YBCO or Tl??CO circuits on standard microwave substrates, to include quantification of the temperature gradients and demonstration of structural integrity and continued operation of stack after >50 thermal cycles.

PHASE I: Contractor will devise and simulate a scheme for bonding double sided HTS chips on opposite sides of an isothermal plane cooled by a single-stage, closed-cycle cryocooler.

PHASE II: Contractor will generalize the techniques developed in Phase I to vertical structures containing multiple cooling planes. Experiments should include demonstrations of >5 pole rf filters and HTS interconnects servicing CMOS chips. Proof of concept demonstration of ability to include ferroelectric tuning circuits desirable. Factors determining the relative virtues of increasing circuit area by increasing the area of individual chips vs. increasing the number of layers in the stack should be identified. Lower limits should be established on the mean time to failure of such stacks.

PHASE III: Contractor will transition the packaging technology that has resulted into the development of platform specific wireless and personal communications systems. Insertions as specialty service providers into programs developing high performance computers and specialized function signal processing circuitry is also expected.

COMMERCIAL POTENTIAL: Cellular communications is an industry currently experiencing explosive growth both in the developed world due to the convenience and in the underdeveloped world due to the lower cost of providing the required transmission facilities and other infra- structure. The existing performance advantages will be further enhanced if the device cooling can be incorporated into the basic circuit design without sacrificing rf performance rather than added on. Hybrid superconducting/semiconducting computers are also expected to deliver improved performance in the high end market.

N97-102 TITLE: High-Power Mid-Infrared Diode Laser

OBJECTIVE: To develop a high power compact 3-5 micron diode laser.

DESCRIPTION: Mid-Infrared lasers emitting in the 3-5 micron spectral band have potential applications in radar, laser-guided weapons, laser rangefinders, electro-optical systems which support improvement of capabilities in missile defense and surveillance sensors, remote sensing of atmospheric constituents, wavelength specific medical applications, and spectroscopy. Currently, 3-5 micron diode lasers are based on InAsSb/InAlAsSb, and InAs/GaInSb type II structures. First approach resultedin low power, low temperature laser due to small valence band offsets. Second approach resulted in low power laser due to increased number of interfaces in the laser structure. The purpose of this investigation is therefore to produce high power, high operating temperature lasers emitting in the 3-5 micron spectral band. The research efforts will be directed towards developing a single frequency mode laser leading to internally frequency modulated laser.

PHASE I: Demonstrate the fundamental technologies necessary to produce high power, high temperature 3-5 micron lasers. Design improved /new laser structures and show how the design improvements can be used for these IR laser.

PHASE II: Produce 3-5 micron lasers and demonstrate the high power, high temperature operation.

PHASE III: Develop reliable 3-5 micron laser arrays applicable for laser radar, laser-guided weapons, laser rangefinders, electro-optical systems which support improvement of capabilities in missile defence and surveillance sensors, and medical surgery, pump source,etc.

COMMERCIAL POTENTIAL: Potential applications include laser radar for aircraft and vehicles for collision avoidance, terrain mapping, remote environmental sensing, global wind sensing ,low altitude wind shear detection, toxic gas monitoring, ground water monitoring, (in the medical field)laser-base refractive surgery, miniaturized medical diagnostics equipment, (in the earth sciences field) infrared spectroscopy, range-finding for surveying and cartography. The added range available from a direct-generated laser will permit measurements from aircraft or remote sites without the need to place retroreflectors on the surveyed points. These semiconductor lasers will also be useful in battlefield situations in which toxic gases may be released. They will also be useful for monitoring ambient air quality in enclosed military vehicles(e.g., airplanes, submarines, etc.). Further, direct in-situ monitoring of materials important in military applications, such as lubricants, fuels and other liquids, e.g., water, can indicate purity, degree of degradation, etc. Applications are also possible in point-to-point data links to moving vehicles, and nuclear proliferation monitoring. The laser can be used for integration and characterization with the Multi-Band Anti-Ship Cruise Missile Tactical Electronics Warfare System(MATES), and other DOD related systems requiring directed IRCM.

REFERENCE:
H.K. Choi, G.W. Turner and H.Q Le, " GaSb-based Semiconductor Lasers in 4um Band," Institute of Physics Conference Series No.144, P.1 (1955)

N97-103 TITLE: Advanced Antenna Concepts

OBJECTIVE: To develop compact efficient, wide-bandwidth antennas for communications and multifunctional systems radar.

DESCRIPTION: Navy applications of compact antennas span nearly all frequency bands, from ELF to SHF. In the short wavelength bands, electronically-steered array applications would benefit from small element-to-element spacing because in such geometries, grating lobe structure would be reduced. Commercial applications involve MF, HF, VHF and UHF bands. In Navy applications, in the VHF and UHF bands, stealth characteristics in the antenna may also be desired. The proposal should

describe how the antenna design is applicable to producing low radar cross-sections and to reducing other observable signatures that the antenna may posses. Operating frequencies of interest in the short wavelength regime span 2-20 Ghz.

PHASE I: Describe the theoretical considerations that will make the proposed wide bandwidth antenna both compact and efficient; how elements in an array configuration can be made to possess low radar cross-section and be low in other antenna-signature characteristics; and with a strawman design indicate the technologies that would be employed to fabricate the antenna and to insure that the unique features of the stated goal are achieved in practice.

PHASE II: Fabricate a compact active element or an array of such elements and demonstrate that wide bandwidth operation can be accomplished in a structure that is compact and with a performance that is efficient and free of excessive grating lobe structure.

PHASE III: Working with a commercial partner or a DoD organization, select a specific antenna application and work to achieve an antenna that satisfies the practical requirements of that organization.

COMMERCIAL POTENTIAL: Wide bandwidth antennas, of themselves, provide the opportunity to have a single antenna structure serve many antenna functions. This virtue is of particular benefit to radio frequency band users that have complex communications needs or needs to both communicate and perform object tracking functions. In some applications, a small physical size is desired which possesses electrically steered characteristics that are not degraded by grating lobe structures that arise from the inability to closely space active elements

N97-104 TITLE: Four-Dimensional (4-D) Atmospheric and Oceanographic Instrumentation

OBJECTIVE: Develop instruments/sensors/techniques to measure atmospheric and/or oceanographic parameters.

DESCRIPTION: Innovative sensors and measurement techniques are solicited to obtain marine atmospheric and oceanographic variables (e.g., physical, chemical, optical, geophysical and biological) in 3-D space and time. Regions of application include the air/sea environment of the open ocean, continental slope and shelf and the very nearshore surfzone; and concerns ocean bottom and sub-bottom as well. The instruments solicited can utilize active and/or passive measurement approaches covering either acoustic or E/M frequencies to support remote sensing or in-situ observations. The approach should be to obtain as complete a space and time characterization as possible and/or necessary for the application being considered. Priority is given to those projects which use off the shelf, low cost, low volume components, are of low power and long life, have been demonstrated to be reliable, particularly in harsh environments, and are easy to deploy. Deployment modes may be via autonomous underwater vehicles, piloted or remotely piloted aircraft, oceanographic buoys and moorings (ocean bottom and surface mounted), underway from a ship or aircraft, from a towed body, or in an expendable mode, or other. Some examples of areas of interest (not exclusive) are: (a) Instrumentation to provide 3-D sub-bottom swath imaging capability from which volume scattering strengths of sediments and buried objects; and size and depths of buried objects; (b) Affordable, off-the-shelf systems for measuring mean velocity in the surf zone and to track sediment movement; and (c) Instrumentation/observation techniques to characterize in-situ ocean velocity and scalar turbulence.

PHASE I: Develop a detailed design and engineering description of the sensor/instrumentation system. Include the expected resolution, sensitivity, precision, and accuracy of the variables being measured. Assess the usage of the device in a realistic environment. Detail risk factors of the design and the steps necessary to overcome these.

PHASE II: Develop prototype system, perform in-situ tests, evaluate and document system.

PHASE III: Transition the technology to scientists in the atmospheric, oceanographic and environmental monitoring research communities, to operational DoD systems, and to the commercial community.

COMMERCIAL POTENTIAL: New instruments can be used in a wide variety of commercial environmental monitoring systems.

N97-105 TITLE: MCM Technologies for Detection, Classification, and Identification*/Localization* of Sea Mines and Submarines

OBJECTIVE: Enable airborne and sea platforms to rapidly detect, classify, and identify (D/C/I) sea mines and other objects of similar size and of submarine size.

DESCRIPTION: Sensors used for D/C/I of mines have dramatically improved in recent years. These include airborne LIDAR, underwater laser systems, high resolution sonars, and magnetic sensors. This effort will develop, fabricate, and test sensor system improvements which overcome some of the severe performance limitations of existing sensors due to adverse environmental factors, such as sonar surface and bottom reverberation, especially in shallow waters less than 60 feet and when searching for potentially buried objects. Underwater laser systems are limited by water clarity problems which result in blur, glow, and absorption. Airborne LIDAR systems suffer from water surface reflections which must be gated out, reducing the

sensors' capability to detect surfaced objects. These optical systems also suffer from reduced target contrast in bright daylight conditions.

ASW sonar systems are on the verge of increased capability in littoral wasters. Current designs are performance limited by severe multi-path propagation and reverberation/clutter. Greater computing power in today's signal processsors allow the possibility of sorting out the multi-path arrivals and de-cluttering the received signal. The development of wide frequency band systems, sources and receivers, will allow waveform designs not now available.

The proposed effort will develop technologies which can ameliorate one or more of today's sensor technology limitations.

PHASE I: Develop a technology design for overcoming underwater object sensing limitation(s). One or more designs addressing the same or different limitations is required. In addition, a document clearly explaining the theory of operation and predicted performance enhancement is required for each design.

PHASE II: Fabricate and test a breadboard (experimental) prototype of the sensor enhancement(s) and provide clear and complete documentation of the prototype's final design, functionality, and testing conducted to demonstrate performance improvement(s).

PHASE III: Design, fabricate and test advanced developmental prototype(s) with interfaces to existing and/or new technology sensors or sensor systems.

COMMERCIAL POTENTIAL: The technologies developed will have multiple commercial applications. Airborne LIDAR improvements will enhance the performance of air search and rescue sensors. Underwater technologies will enhance sensors used by commercial diving and salvage companies and the oil industry which uses sensors for oil pipe and cable relocation and inspection.

REFERENCES: Sea Technology (ISSN 0093-3651) published by Compass Publications, Inc., 1117 North 19th Street, Arlington, VA 22209

N97-106 TITLE: Underwater Acoustic Communications Channel and Network Optimization

OBJECTIVE: To optimally configure an underwater acoustic communications network to maximize surveillance functions, while minimizing the power used by sensor nodes, and to estimate the impulse response of an underwater acoustic channel, including time-varying arrival structure, Doppler, and frequency spreading characteristics, using only historical sound velocity profile (SVP), existing physical oceanographic data, sensors spatial properties, and motion dynamics of sensor platforms.

DESCRIPTION: Consider the case of a network (fixed or mobile) of sensor nodes and a master node. In order for most sensor nodes to communicate to the master node, a message must be relayed from sensor node to sensor node until it reaches the master node. The goal is to determine optimal communications routes from each sensor node to a master node and to be able to adapt to problems, such as changes in environment , sensor outages, etc. There are several unique challenges- node-to-node paths must be short due to underwater acoustic propagation limitations, to avoid draining a node's power prematurely there must be a limit to the number of routes each node can participate in, message rate and size are limited by power consumption constraints, and communications bandwidth may be limited to extend minimum communication range. The propagation path, which to a large extent is influenced by the characteristics of the physical ocean acoustic channel, affects node-to-node underwater communication. The acoustic channel impulse response provides an indication of multipath and frequency spreading characteristics of a particular channel. The problem is to determine a means to accurately describe the channel impulse response using only historical sound velocity profile (SVP), existing physical oceanographic data, sensors spatial properties, and motion dynamics of sensor platforms. The impulse response could then be used to initialize both coherent and non-coherent communication nodes' algorithms. This is particularly relevant to the operation of joint, adaptive synchronization and equalization algorithms.

PHASE I: Create an objective function and associated constraints for dynamically determining the optimal routing of the communications network. Develop models or modify existing models to predict the time-dependent ocean channel impulse response structure peculiar to a specific ocean environment, using only historical SVP data, *a priori* bathmetry data, and source/receiver depths. Validate the model by comparing its impulse response estimates with actual response data found in the literature and/or online.

PHASE II: Create a test bed to evaluate candidate communication routing algorithms. Incorporate an analytical tracker in a Monte Carlo simulation to quantitatively evaluate and compare the candidate algorithms. Develop appropriate Measures of Effectiveness (MOEs) to evaluate the candidate algorithms. MOEs should address the value added to the surveillance product for a message sent to the master node, and be incorporated into the objective function to weigh this against the power consumed by sending the message. Perform in-water experiments to validate the IR model predictions for selected ocean areas and two frequency regimes: 2-4 kHz and 10-40 kHz. The IR model predictions will be used to initialize the joint, adaptive synchronization and equalization algorithms in the tactical acoustic modems.

PHASE III: Implement one or more routing algorithms identified (in phase II) as most efficient for optimizing and controlling communications into a prototype master node. Implementation is to provide for dynamic control of the routing and the decisions as to send a message for a network of sensor nodes to be controlled by the master node. Integrate the IR model algorithms with existing tactical modem software/hardware and provide any additional software/hardware required to effect this integration.

COMMERCIAL POTENTIAL: Acoustic communications are currently being evaluated for applications in oceanographic research, underwater vehicles, and recreational diving. Optimal acoustic communications networks would be useful for communicating to researchers/drones when there is not a direct communications link. This technology would be applicable to needs wherever there is a requirement for remote underwater connectivity.

REFERENCES: Stojanovic, M., "Recent Advances in High-speed Underwater Acoustic Communications," *IEEE Journal of Oceanic Engineering,* April 1996.

N97-107 TITLE: Light-Weight Satellite Sensors for Space Environment Sensing

OBJECTIVE: To develop a new generation of light weight and/or in-situ or remote sensing instruments to fly aboard new generation of mini and micro satellites for space environment sensing.

DESCRIPTION: The trend towards smaller satellites combined with increasing delays for access to spaceflight point to the need for new generations of small, low weight and low power space sensors to take advantage of opportunities for space flight as secondary payloads. Environmental parameters of interest include the electron and ion densities in the ionosphere, magnetosphere and plasmasphere, and the energy and composition of the trapped and precipitating charged particle environment. Additional consideration will be given to light weight satellite bus technology and the development of new generations of small atmospheric sensors for remote sensing of temperature, density, composition and density. Many current space sensors are too large or require too much power to be accommodated on micro satellites. Sensors are needed for inclusion on satellites with total weights in the range 50 - 200 kg. Both in-situ instruments such as ion mass spectrometers and remote sensing sensors such as topside sounders and UV/X-ray imagers are considered. Sensors with minimal external pointing requirements, or innovative self-pointing on crude pointing platforms are needed. New detector technologies and innovative electronics packaging technologies are required. Small satellite buses with self-contained power, pointing, command data handling will also be considered.

PHASE I: Conduct and present a design study incorporating innovative and light weight/low power technology to develop a new generation of sensor for space or atmospheric sensing including tradeoffs between size, weight, power and performance.

PHASE II: Fabricate a laboratory version of the sensor. Test the sensor in the laboratory to verify sensing capability and evaluate instrument sensitivity and signal to noise ratio compared to design parameters. Perform environmental testing or modeling to ensure that instrument designs will address the rigors of the space environment.

PHASE III: Build a spaceflight qualified instrument for flight aboard a host satellite. Instrument must have completed and documented mechanical, electrical, command and telemetry interfaces. Adequate testing and calibration of the instrument must be completed to verify the functionality of the sensor and the suitability of the instrument for spaceflight on a mini or micro satellite.

COMMERCIAL POTENTIAL: A new generation of space sensing technology can be used to extend the life of commercial satellites by providing advanced warning of charged particle and space environmental hazards. Ionospheric sensing instruments will improve the operation of a number of commercial space systems which are currently affected by ionospheric variability on the propagation of radio frequency signals.

N97-108 TITLE: Growth of Single Crystal Piezoelectrics

OBJECTIVE: Grow single crystal piezoelectric materials for high performance acoustic transducer and electromechanical actuator applications.

DESCRIPTION: Recent research results have established that relaxor-based single crystal piezoelectrics have exceptional performance characteristics compared with conventional alternatives for acoustic transduction and electromechanical actuation, for example, electromechanical coupling exceeding 90%. These materials promise enhancements of more than an order of magnitude for broadband Navy sonar transducers and civilian medical diagnostic transducers, as well as for electromechanical actuators used in shipboard and civilian vibration control applications. To commercialize these materials, cost-effective crystal growth methods are sought which produce materials in the size and form required by these diverse application domains.

PHASE I: Demonstrate a crystal growth technique that yields piezoelectric single crystals with high electromechanical coupling and high actuator authority.

PHASE II: Develop a cost-effective crystal growth method and apparatus for the production of piezoelectric single crystals of size and form suitable for acoustic transducers and electromechanical actuators. Demonstrate performance in prototype device configurations.

PHASE III: Manufacture piezoelectric single crystals for processing into acoustic transducers and electromechanical actuators.

COMMERCIAL POTENTIAL: These high performance piezoelectric materials will have application in broadband ultrasonic transducers used in medical diagnostic imaging, and in high strain electromechanical actuators used for vibration control in air-conditioners, automobiles, and aircraft.

REFERENCES: Seung-Eek Park and Thomas R. Shrout, "Characteristics of Relaxor-Based Piezoelectric Single Crystals for Ultrasonic Transducers," Proceeding of the 1996 IEEE International Ultrasonics Symposium.

N97-109 TITLE: Miniature Diode Laser Velocity Sensor

OBJECTIVE: Develop miniature Laser Doppler Velocimetry (LDV) probes utilizing commercially available visible laser diodes, avalanche photodiodes, and miniature optical components, for fluid velocity measurements where space is constrained and only local battery power is available.

DESCRIPTION: The LDV measurement technique has unique characteristics including non-intrusiveness, fast response, and high accuracy. However the size, power requirement, complexity, or cost of standard LDV measurement systems often makes them impractical for many fluid velocity measurement tasks. Replacing ion gas lasers and photomultipliers with visible diode lasers and avalanche photodiodes would result in a significant cost reduction and an even greater reduction in electrical power and component size. This effort would develop a miniature two-component LDV probe suitable for size- and power-constrained applications.

PHASE I: Conduct a 6 month effort to evaluate components and design alternatives for a two component diode laser velocimetry probe. Produce a waterproof, working prototype probe for evaluation by the Navy.

PHASE II: Explore techniques to add laser beam frequency shifting or its equivalent to the diode laser based sensor and to produce a family of miniature LDV probes with various sizes, frequencies, power, and focal lengths.

PHASE III: Refine manufacturing techniques to increase robustness of the probes and to lower instrument costs. Produce and sell a commercial product that can be used with available LDV signal processors and software from other LDV equipment manufacturers.

COMMERCIAL POTENTIAL: Small, low power, LDV probes with completely self contained optics would open up many new applications areas for LDV in the marine, aerospace, chemical, and automotive vehicle industries. They would be particularly important to the nonintrusive measurement of flow around autonomous vehicles and models, and in remote locations with limited access.

REFERENCE: Coughran, M. and D. Fry, "Expected Capability of Multiple - Probe LDV Propulsor Inflow Measuring System," CDRKNSWC/HD-1308-01, (Feb. 1990).

N97-110 TITLE: Ultrasonic Diagnostic Imaging Transducers for Combat Casualty Care

OBJECTIVE: Devise, develop and fabricate medical ultrasonic imaging transducers with enhanced performance characteristics: sensitivity, bandwidth, or element count.

DESCRIPTION: The use of medical diagnostic imaging in forward echelons on the battlefield provides a means for the early diagnosis and effective treatment of combatant wounds, offering the possibility of reducing the nearly 50% of battlefield casualties who die on the field for lack of timely diagnosis and treatment. A critical component in these ultrasonic imaging devices is the transducer that generates the probing pulse as well as detecting the returning echoes. This topic seeks innovative transducer designs and fabrication methods that are particularly suited to the requirements of field deployable imagers for defense applications; such designs and methods should also be broadly applicable to civilian diagnostic imaging requirements in trauma care and more conventional application arenas.

PHASE I: Design, fabricate, and test prototype transducers that enhance performance in one or more operating characteristics over conventional transducer designs.

PHASE II: Develop a cost-effective method for manufacturing the new transducer design and demonstrate performance in a medical ultrasonic application for combat casualty care.

PHASE III: Manufacture the new transducers for application in medical diagnostic imaging devices used for combat casualty care as well as in standard civilian applications.

COMMERCIAL POTENTIAL: Medical ultrasonic diagnostic imaging transducers that meet defense combat casualty requirements will find even larger markets in civilian trauma care. The civilian medical ultrasonic imaging market -- approaching $2 billion in annual sales -- provides a substantial opportunity for any technology developed.

REFERENCES: Annual Proceedings of the IEEE Ultrasonics Symposium and Annual Proceedings of the American Institute of Ultrasound in Medicine Meetings

N97-111 TITLE: Self Assembled Monolayer Based Methods for Materials Processing and Device Fabrication

OBJECTIVE: To exploit the ability of self assembled monolayers (SAM) to process small scale features and/or to chemically or electronically passivate surfaces thereby aiding in the development of low cost manufacture, enhanced performance, and/or longer life of electronic and optical materials/devices.

DESCRIPTION: Recently there have been significant advances in the development of self assembled monolayer science and technology. The ability to pattern extremely small scale features and structures using self assembly "stamping" techniques has been demonstrated by a number of researchers. Much of the work to date has focused on defining the limits of this process for fabricating small scale features and the type of materials and structures which could be stamped. As this research has developed, more sophisticated issues such as registry in multi- layer patterns, printing on non-uniform surfaces, and sagging in stamps have emerged. It has also been demonstarted that SAMs can can be used to chemically passivate surfaces such as those of superconductors which leads to increased atmospheric stability of these materials. Still, a number of key issues remain to further develop a passivation process based on SAMs which can be extended to a variety of material systems (semiconductor and superconductor). The ease with which self assembled monolayer processing methods have been implemented in laboratories across the country suggests that they could be easily integrated into a variety of manufacturing processes for electronic and optical materials. This Phase I program is specifically designed to exploit and use SAMs in electronic and optical materials/device manufacturing processes.

PHASE I: The phase I effort will focus on design of electronic or optical materials/device fabrication processes which could see a significant reduction in manufacturing cost and/or a significant enhancement in materials/device performance as a result of implementation of this new SAM-based processing technology.

PHASE II: The phase II demonstration of the new process should delineate and focus on the key technical challenges to implement the SAM-based process in a real manufacturing environment. Preliminary cost analysis will be undertaken and verification of enhanced performance and reliability will be addressed as is appropriate.

PHASE III: Emphasis will be placed on implimenting a prototype manufacturing process which exploits the SAM-based processing developed in Phase I and II; cost, throughput, reliability and market issues will be fully addressed.

COMMERCIAL POTENTIAL: The commercial potential of SAM-based processing technologies is enormous. Typical methods to produce fine detailed structures in electronic and optical materials/devices require a large number of processing steps. By using SAM-based techniques the number of processing steps could be reduced, throughput increased and overall manufacturing cost lowered. Furthermore the use of SAMs for chemical and electronic passivation of materials and devices can significantly enhance the performance and lifetime of such devices.

N97-112 TITLE: Computer-based Training for Adult Literacy Enhancement

OBJECTIVE : Design, develop and evaluate training software to improve the reading competence of adults currently reading at the grade 5-9 level.

DESCRIPTION: The Navy has a need for computer-based training (CBT)/ educational software for use in developing the reading skills of naval personnel. This CBT must be suitable for use in independent study, without the support of an instructor or traditional classroom setting. It should be targeted for an adult student population rather than for a younger K-12 population. Further, it should be targeted for a population that has mastered basic reading skills of decoding and has attained a reading grade level of at least grade 5 and perhaps as high as grade 8 or 9. The aim would be to advance these readers towards grade 12 reading competence, the average competence of a high school graduate. There would also be interest in CBT that gives special attention to special needs of bilingual personnel whose first language is not English. Little is available that currently meets these requirements: adult literacy programs typically aim too low, at truly illiterate non-readers, whereas the content of programs

designed for school children is usually inappropriate for adults. Offerers are invited to propose and argue for instructional approaches appropriate to obtain the stated goals. It is assumed that at least one appropriate element of an instructional approach would be computer-supported reading practice. For this purpose, the CBT should incorporate reading materials appropriate for the adult interests of a diverse population, including women and members of various cultural minorities. In addition, it should provide for Navy instructors or others to enter new, job-related materials with a reasonable amount of authoring effort. The project plan should include research that will test the effectiveness of the CBT instruction in improving reading competence, as well as plans for commercial productization.

PHASE I: Design and prototype CBT and authoring or entry of new practice materials.

PHASE II: Develop CBT, incorporate appropriate reading material libarary, obtain rights to materials, experimentally evaluate both training effectiveness and ease of authoring or entry of additional reading materials.

PHASE III: Transition CBT to Chief of Naval Education and Training shipboard and other learning center training and/or to comparable groups in the other military services.

COMMERCIAL POTENTIAL: CBT software has massive commercial potential for use in civilian educational institutions and/or in industrial remedial basic skills training programs.

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1. Frederiksen, J. R., Warren, B., and Rosebery, A. (1985)A componential approach to training reading skills: Part I. Perceptual units training. Cognition and Instruction, 2(2), 91-130.
2. Frederiksen, J.R., Warren, B.M., & Rosebery, A. S. (1986). A componential approach to training reading skills: Part II. Decoding and use of context. Cognition and Instruction, 2(3&4), 271-338.
3. Joyce Harvey-Morgan, Moving Forward the Software Development Agenda in Adult Literacy: A Report Based on the Adult Literacy Software Development Conference. Practice Report PR96-02, May 1996, National Center on Adult Literacy, University of Pennsylvania.
4. M. A. Just & P.A. Carpenter, The Psychology of Reading and Language Comprehension. Boston: Alleyn & Bacon, Inc. 1987.

N97-113 TITLE: Detection and Tracking of Human Combatants by an Unattended Video Surveillance Device in Urban Environments

OBJECTIVE: Design and build an inexpensive portable active vision unit that can be deployed in urban environments, that can function unattended, and that is capable of continuous monitoring of wide fields of view, detecting and tracking humans, determining if they are combatant, and reporting "suspicious" activity.

DESCRIPTION: Recent advances in PC and video hardware as well as algorithmic advances in pattern analysis from video---especially those inspired by the understanding of how the human visual system works ---are making possible a new generation of inexpensive real-time vision systems. This technology has been demonstrated in commercial computer systems for automatically locating humans in live video, extracting their faces, recognizing and tracking them. The current effort would use existing technology to develop a video surveillance system that has the additional capability of discriminating between combatant and non combatant personnel in the field of view in an urban environment. It would also be able to track human movement and determine if there are any "suspicious" patterns of activity. This necessarily would be an active vision system with pan/tilt zoom capabilities on the video camera(s) to allow operation over a wide field of view while at the same time being able to perform detailed pattern matching to determine if a person is a combatant. The system could use in addition infrared sensors integrated with the video camera to improve robustness of operation in reduced lighting conditions and to help spot carried weapons.

PHASE I: Develop overall system design that includes specification of video surveillance and recognition technology, sensor specification, and protocol of operation.

PHASE II: Develop and demonstrate a prototype system in a realistic environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III: Integrate cost effective systems for large scale field deployment.

COMMERCIAL POTENTIAL: This system could be used in security applications where automatic surveillance and tracking are necessary.

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1. Alyea, L.A., Hoglund, D.E., Eds. Human Detection and Positive Identification: Methods and Technologies, SPIE, 1996.
2. DePersia, A., Yeager, S. and Ortiz, S., Eds. Surveillance and Assessment Technologies for Law Enforcement. SPIE, 1996.

N97-114 TITLE: Biologically Motivated Neural Processing Architectures for Multi-Spectral Fusion

OBJECTIVE: Develop software and later, hardware to perform multi-frequency fusion in real-time, with emphasis on the fusion of video data. Emphasis is on the integration of current sensor systems. No specific wavelengths are emphasized, rather any combination of the electro-optical-infrared (EOIR) spectrum is acceptable. The ultimate goal is a modular signal processor capable of integrating from 2-10 bands and producing a signal for a conventional color display.

DESCRIPTION: Current emphasis on "first on the scene" discrimination of strategic mobile targets (SMTs) requires an ability to fuse visual sensor-data in real-time. Biological systems which have fusion capability also exhibit color contrast enhancement, color constancy and target background separation with a low S/N. Suggested solution to the invisible spectrum fusion problem may make use of biological principles. The final product should embody a number of algorithms capable of image preprocessing using a variety of inputs from various sensors or multiple bands from a single sensor. This product should be modular or reconfigurable and adaptable to a wide range of applications.

PHASE I: Develop, test and operationally demonstrate a complete multi-frequency sensor fusion system. Compare with alternative methods, networks, and algorithms. Field test.

PHASE II: Produce and demonstrate a complete product incorporating lessons learned in Phase II. Possible Navy programs include TMD, Tomahawk, Advanced Avionics, Real-time Retargeting, and Smart Weapons.

PHASE III: Produce a complete product incorporating lessons learned in Phase II.

COMMERCIAL POTENTIAL: Imagery fusion in real time has application for civilian aircraft, any traffic (land, sea, air) control system, multi-media presentations, and human-machine interactions such as color contrast enhancement, color constancy and the reduction of S/N.

REFERENCE: Scribner, D. Infrared color vision. IRIS Proceedings on Targets Background and Discrimination. Jan '96.

N97-115 TITLE: Remotely Operated Undersea Vehicle (ROV) Pilot Training System

OBJECTIVE: Enable pilots of remotely operated undersea vehicles to develop and practice critical operational skills without requiring the use of expensive operational assets.

DESCRIPTION: Undersea ROV pilot training is generally obtained on the job and is often limited by the cost of system deployment, the lack of availability and the high cost of operational assets. A self-contained simulation-based training system would allow pilots to learn and practice critical skills prior to operation of the actual operational systems. For Navy applications, it is particularly desirable for the system to be low-cost and compact, allowing it to be used shipboard, in the classroom or in operational locations.

PHASE I: Design a self-contained prototype training system for ROV pilots. Address issues of critical skills to be taught, techniques and technologies to be incorporated including instructional strategies, portability, configurability, and cost. Perform feasibility demonstrations. Develop hardware and software specifications for prototype construction in Phase II.

PHASE II: Construct prototype of system designed in Phase I. Develop self-contained software package for operation of system. Perform formative evaluations of critical system components. Demonstrate effectiveness of system through training transfer tests, showing the utility of the system as used with a representative ROV system.

PHASE III: The prototype system will be applied and demonstrated for Navy mission areas, including mine countermeasures, search and salvage, and submarine rescue. Commercial applications will also be pursued as described below.

COMMERCIAL POTENTIAL: Increasing commercial use of ROVs has increased the need for training and certification of pilots. The off-shore oil and gas industry is currently the largest user of such systems (300-500 currently active in the field), and both personal and product liability issues are imposing the need for certified operators. Other areas requiring trained and certified operators include hydroelectric, inshore infrastructure and ship hull inspection.

N97-116 TITLE: Hard-Target-Penetrator End-Game Guidance

OBJECTIVE: Use kinematic global positioning system (GPS) to provide guidance and control for a hard target penetrating missile for location, attitude and impact angle that will maximize target penetration.

DESCRIPTION: The performance of hard-target penetrators is substantially improved by striking the target precisely at the correct point with the correct angle. “Correct angle” means both that the velocity vector is pointing optimally and that the missile body is pointed correctly relative to the velocity vector. In the simple example of a large horizontal slab, the optimum impact would be at the center of the slab, with the velocity vector vertical and zero pitch or yaw angle. Kinematic GPS provides the capability, at low cost, to accurately measure the missile’s state, and ensure that this optimum impact is achieved. The purpose of this SBIR topic is to address the following factors needed to use Kinematic GPS in this way:

- Extraction of attitude and velocity information from the GPS signal
- Communication of the kinematic parameters from a base station to the missile, to achieve
- Action, by the missile autopilot, to use the GPS information to achieve the precise impact.

Goals are impact accuracy of 0.1 meter, with velocity vector and attitude accurate to 5 mils The interface to the autopilot should be adaptable widely differing plants, since the technique should be usable in a large supersonic missile (500 pound warhead) or a gun-launched projectile (30 pound warhead), and would also be adaptable to gravity bombs and direct-fire ground and aircraft weapons.

PHASE I: Design the system, including the GPS receiver, communications with the base station, and interface with the autopilot and missile plant. Describing the theory of operation, estimated performance, and technical risks associated with the Phase II development.

PHASE II: Construct and demonstrate hardware for the GPS receiver and base station data link. Demonstrate the guidance method in a simulation.

PHASE III: Transition to potential gun and missile systems, including the Naval Support Fire System (NSFS) projectile program, Low Cost Missile System, and ScramShell gun projectile.

COMMERCIAL POTENTIAL: Accurate state measurements using Kinematic GPS are under development for commercial aviation uses, to provide Category II and Category III precision approach and landing, and attitude measurement to back up gyrocompasses and magnetic compasses. Other applications range from conventional navigation, surveying and map making, to traffic management and agriculture. Accurate azimuth positioning is important to mapping and automatic location of features like road signs, utility poles, and fire hydrants.

N97-117 TITLE: Virtual Laser - Kinematic Global Positioning System (GPS) Terminal Guidance from Spotter to Projectile

OBJECTIVE: Develop the navigation components, algorithms, and communications connectivity to allow a mobile or stationary remote sensor to survey and direct a vehicle to a detected or designated object using Kinematic GPS, including relative speeds and distances.

DESCRIPTION: Military background - In the military application, the remote sensor will be a spotter, the vehicle will be a projectile, and the detected object will be the target. Current semi-active laser designation for bombs, missiles, and projectiles has substantial tactical advantages: The impact point is extremely accurate. Moving targets can be hit. The firing platform need not see the target. Most importantly, the spotter has full control of target aimpoint selection. However, laser designation also has limitations: The laser alerts the target. Successful designation requires visibility from the spotter to the target and then to the projectile. The projectile still must be fired into a highly accurate and small acquisition basket. Finally, the semi-active information does not provide range to the target or time-to-go, reducing our capability to support stand-off fuzing, air bursts, or submunition payloads dispensing. This topic seeks approaches to the use of Kinematic GPS, coupled with accurate measurement of an object's position relative to a remote sensor, to guide a vehicle with laser-like accuracy, but in a more flexible system. The basic concept is to provide the remote sensor with a carrier-phase-sensing GPS receiver and the ability to transmit to the vehicle. The sensor will measure the relative position of the target and transmit that offset, plus its GPS position. The sensor may measure the position of the target in a variety of ways: stationary targets can be measured by triangulation or by placing the GPS receiver at the target object during a mapping effort (in military applications, before the battle--preparing a defensive position, for example). Moving targets can be ranged with a theolodite and laser rangefinder. Airborne spotters can use passive ranging techniques, radar, or lasers. A beamriding approach, where the vehicle moves along the sensor-target line, should be feasible if range information is not obtainable. (Developing these techniques is not part of this topic.) However, the remote sensor will have only a low-quality inertial platform, so the system will have to address angular alignment of the sensor, (that is, the sensor's knowledge of north and vertical). This issue, along with the relative positioning of the vehicle with respect to the sensor and the communication from the sensor to the vehicle are the heart of this topic. Given these capabilities, the goal is to obtain a 1 meter CEP for a target 1 km from the observer.

PHASE I: Develop a design for this system, including algorithms for Kinematic on-the-fly relative positioning, data communication to the incoming projectile/vehicle, and techniques for alignment of the spotter/sensor north and vertical references. A variety of methods may be appropriate since some spotters (for example, aircraft) will be moving, while others may not be able to move (for example, a concealed Marine). Analyze the sources of error and describe the range of conditions under which the system will meet the 1-meter CEP goal. Recommend commercial off-the-shelf components where possible, striving for a system that is easily portable in the field and suitable for use on a small UAV.

PHASE II: Demonstrate the system using brassboard spotter hardware and a surrogate vehicle simulator (portable receiver that will show range and direction to the aimpoint.) Success is shown when the vehicle simulator correctly points to the aimpoint and is within 1 meter of the aimpoint when it reads "at aimpoint"

PHASE III: Incorporate the projectile's portion of the system into the EX-171 Extended Range Guided Munition, and the spotter's portion into the FO/FAC (Forward Observer/Forward Air Controller) equipment.

COMMERCIAL POTENTIAL: The relative navigation and data communications developments are directly applicable to air, sea, and land navigation needs, including precision aircraft landing, smart vehicle/highway systems, oil and gas exploration, agriculture (Ref 3), and environmental surveys. The accurate angular measurements needed are applicable to surveying and map making. This enables improved map making, allowing, for example, a Public Works department to survey its streets and accurately locate every street sign, manhole, pothole, and utility poles, possibly from a moving vehicle.

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2. Schmidt, George, and Roy Setterlund, "Precision Strike Concepts Exploiting Relative GPS Techniques, Navigation: *Journal of* the Institute *of Navigation, Vol.*41, No. 1, Spring 1994, pp 99-112
3. Roberts, Gwyn, et al., A Low-Power Postprocessed DGPS System for Logging theLocations of Sheep on Hill Pastures," Navigation: *Journal of* the *Institute of Navigation, Vol.* 42, No 2, Summer 1995, pp. 327-336.

N97-118 TITLE: Compact Sensors and Guidance for Mid-Caliber Naval Guns

OBJECTIVE: Develop Compact Sensors and Guidance for Rotating, High G, High Speed Bodies

DESCRIPTION: Military Application -- One of the most important applications of mid-caliber (5-inch) Naval guns is in meeting the defensive requirements of the Close-In-Weapon-system (CIWS). The function of the CIWS is to engage and defeat aircraft and cruise missile threats that have avoided the extended range of area defenses. The proposed sensor and guidance system must be small enough to be compatible with the existing nose cavity as used in the Navy's 5/38 and 5/54 projectiles. The compact seeker might use an IR (Infra-Red) detector with central frequency and bandwidth. Cooling for the IR detector could be achieved after launch, possibly through a sudden piston motion during launch setback. Recently developed miniature radar

detectors could also be considered as an alternative. Energy for the power system can be obtained from the conversion of a small amount of projectile spin energy converted to electrical energy.

PHASE I: Demonstrate feasibility of a spinning compact detector/sensor suite, such as IR with cooling provided by setback. This should include development the equation of motion of the supporting spinning body, to which is applied an inertial-fixed precessional moment.

PHASE II: Develop a proof-of-concept sensor/seeker that can be gun launched with a transducer/telemetry package. The telemetry should measure rotations and sensor data at 250 meters downrange. Witness cards can be used to determine lateral movement and acceleration. Develop a bread-board of sensor/seeker and guidance system of a type suitable for laboratory demonstration.

PHASE III: Develop a compact sensor/fuze replacement that can be used in a trials program to despin a Naval Projectile. The seeker would acquire a stationary source (such as the Sun if an IR seeker is used); the controller can then input a step to the maneuvering fins of a 5 inch naval projectile.

COMMERCIAL POTENTIAL: The development of inexpensive, compact, high G, IR or radar detector can provide general aviation aircraft or commercial transportation systems a compact, reliable, low cost alternative (or confirming sensor/agent) to existing anti-collision radar systems.

N97-119 TITLE: Thermographic Technology Development for Real-Time Fault Detection

OBJECTIVE: Enable real-time, on-site detection of structural and machinery faults and corrosion in air, surface ship and submarine platforms.

DESCRIPTION: High resolution infrared (IR) thermal imaging technologies have the potential to be a useful tool for detection of faults in machinery and structures. Observation/analysis of thermal patterns (in real time) can provide go/no-go checks and can simplify the diagnosis of machinery and structural members. Thermal imaging can also be used as a post mission analysis tool to determine deterioration of components. Thermal imaging can be combined with other health and usage monitoring technologies to reduce false alarms and improve diagnostic capability for naval surface, subsurface and air assets. Flaws of interest include but are not limited to corrosion of hidden aircraft structures and/or critical components, such as helicopter rotor heads, corrosion or corrosion/erosion (of piping systems) under insulation, and hot spots due to bearing degradation. The net benefit will be enhanced safety and affordability, improved readiness, lower false removals, accurate fault detection, and, conservation of assets.

PHASE I. Establish feasibility to detect typical flaws in machinery and structures using passive infrared thermal imaging. Identify IR- thermal signatures and establish pattern analysis approaches for fault-specific classification.

PHASE II. Develop an operable field-prototype and demonstrate on several types of naval machinery and structures. Acquire a data base for no-fault cconditions and multipal (actual) fault-types. Demonstrate pattern analysis approach for specific fault identification.

PHASE III. Transition to industry for commercialization and extension of fault identification data base.

COMMERCIAL POTENTIAL: Health monitoring in commercial shipping, rail, truck, electric power, heavy construction equipment and commercial air transportation industries.

REFERENCES: OPNAVINST 4790.2, Naval Aviation Maintenance Program

N97-120 TITLE: Intelligent Control Algorithms and PC-Based Software Tool Development for Multiple Effector Control Systems

OBJECTIVE: To use intelligent control techniques, such as fuzzy control and/or neural networks, to develop optimal control algorithms for systems controlled by multiple actuators and effectors in a PC-based software tool for the efficient design or development of algorithms.

DESCRIPTION: The requirements of future systems (such as aircraft, submarines, missiles and spacecraft) are being driven to have improved performance and to perform multiple roles. In order to accomplish these objectives, systems are being designed to be reconfigurable or to have new or additional control effectors. In addition, the resulting control design should be robust to modeling errors, parameter uncertainties and variations, and system noises and errors. As a result, the design of the control system is becoming more complex, especially in developing the optimal control for the integration or blending of various actuators and control effectors. Intelligent control technologies (such as Fuzzy Control and/or Neural Network control) can be utilized to effectively control these types of systems. The successful application of these technologies to other systems and the

commercialization of computer chips to perform these types of processes make these technologies appealing. Thus, this task will develop fuzzy and/or neural or other intelligent control algorithms for multiple actuated and controlled systems. In addition, a PC-based software tool is to be developed to allow for a more efficient design process utilizing the intelligent control technologies. The control algorithms are to be robust to modeling errors, parameter uncertainties and variations, and system noises and errors. The algorithms are to be tested in a simulation. The results should be compared to those of systems that utilize traditional or conventional control design approaches. A first version of PC-based software is to be developed, incorporating the traditional and intelligent control methods. This software can either be a stand-alone tool or a toolbox to existing software such as MATLAB. This intelligent control software tool should be flexible and user friendly, to allow for efficient intelligent control design.

PHASE I: Intelligent control algorithms are to be developed for systems with multiple actuators and control effectors.

PHASE II: In Phase II, real time implementations of the control algorithms are to be developed and demonstrated via hardware-in-the loop simulation. Performance improvements should be verified for a few operating conditions, comparing the hardware-in-the-loop results with those found via detailed digital simulation. In Phase II, the software is to be revised and upgraded to make it commercial ready. Beta-testing of the software shall be performed to ensure thoroughness and completeness.

PHASE III: In Phase III, algorithms for actual system operation and implementation are to be demonstrated via hardware-in-the loop simulation and/or actual system test demonstration. Algorithm performance shall be assessed considering the full range of system operating conditions.

COMMERCIAL POTENTIAL: Applications of these approaches for aerospace and transportation industries are beneficial. In particular, these intelligent control techniques could be applied to aircraft, submarines, ships, satellites, missiles, launch vehicles, intelligent transportation vehicles and systems, and other systems with multiple actuators and control devices.

N97-121 TITLE: Biologically Inspired Processor for All-Source Data Association and Fusion

OBJECTIVE: Development and application of biologically inspired data processing methods, techniques, or algorithms, such as artificial neural networks, to underwater vehicles requiring real-time all-source information association and data fusion, with emphasis on the processing of acoustical information.

DESCRIPTION: Future undersea warfare, in the littoral environment, will present much shorter engagement ranges, new threats, environmentally imposed uncertainties, and the higher likelihood of melee encounters. Such factors combine to make the task of data association and fusion for target track estimation and tactical picture generation much more important and difficult than for deeper water. The Navy has adopted, on a science and technology level, a biologic based system as a tracking component of a contact management subsystem within the submarine combat control system. This component, Neurally Inspired Contact Estimation (NICE), uses contact associated data to enhances current capabilities for all-source, real-time data assimilation, fusion, and correlation. This topic seeks a processor capable of associating and combining acoustic and non-acoustic data with individual contact tracks in real-time for input to NICE. The input to this processor is multi-channel data (typically 30 channels) at refresh rates on the order of 0.1 second or less. The output of this processor is contact associated data provided at one second intervals.

PHASE I: Demonstrate the feasibility of a biologic based system for accomplishing contact data association for two or more contacts. The demonstration should incorporate synthesized data from two or more sensors/sources of acoustic/non-acoustic nature.

PHASE II: Full algorithm development and validation with assessment of system performance against synthetic data as well as pre-recorded data from at-sea exercises, encompassing intermittent and uncertain data on several constant motion as well as maneuvering contacts. Deliver software module(s) that can be interfaced with NICE system.

PHASE III: Transition to production as part of the NICE component of the contact management system.

COMMERCIAL POTENTIAL: The techniques, methods, and algorithms will have direct relevance to any application requiring real-time data association, assimilation, fusion, and correlation -- for example: military and Federal Aviation Administration (FAA) aircraft tracking systems, National Oceanic and Atmospheric Administration (NOAA) systems for localizing, tracking, and predicting forest fire flame fronts or fish school populations, as well as Department of Transportation (DOT) systems for localizing, tracking, and direct traffic.

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2. "Neural Network Based Data Fusion System for Source Localization", C.M. DeAngelis and R.W. Green, United States Patent, Number 5,537,511 of 16 July 1996.

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4. "Neural Network Based Three Dimensional Ocean Modeler", C.M. DeAngelis, United States Patent, Number 5,488,589 of 30 January 1996.

N97-122 TITLE: Affordability Measurement and Prediction Technologies

OBJECTIVE: Beginning with theoretical foundations, develop a decision support system for program managers of complex systems.

DESCRIPTION: Affordability of all Navy warfighting and support systems is a major concern in the Department of Defense. From the time a required operational capability is articulated, weapon system affordability must be an issue. The ability to effectively define requirements; generate viable concepts, approaches, and designs; and select the most affordable of these alternatives will depend on the ability to measure the affordability of existing systems and predict the affordability of alternatives. The ultimate acquisition payoff will be the confidence that the most affordable systems will be developed and fielded, and the knowledge of the degree to which expected affordability has been achieved. With this background in mind, ONR is pursuing research and development in the areas of affordability measurement and prediction. For purposes of this research, affordability has been defined as the characteristic of a system that enables it to be procured when it is needed, supported so it remains available as needed, and operated at the level of performance quality desired within the (life cycle) budget allocated to all systems being procured and operated. The goal of this research is to provide high confidence methodologies and tools to assist in making technological decisions that impact the affordability of new and current Naval systems. However, the results of the research may be applied across the Department of Defense as well as in the commercial world.

PHASE I: Determine the theoretical bases for developing executable models that relate to measuring the affordability attributes of complex weapon systems.

PHASE II: Develop mathematical models and measures of effectiveness that characterize the relationships between the parameters that define affordability. Validate the fidelity and robustness of the model by simulating within a pilot DoD program.

PHASE III: Transition these mathematical models into a decision support system for program managers of complex systems.

COMMERCIAL POTENTIAL: The ability to measure and predict the impact of developing technologies on emerging products in the commercial sector could affect consumer economics as well as military system affordability. There is general agreement that dual-use technology development can be a vital affordability enabler for commercial products and for military systems that use those products or variants. So far, the commercial sector has found no effective way to characterize and measure the affordability attributes of existing or emerging technologies or to predict their effect on complex commercial and military systems. Consequently, results of this research could have significant potential for broad commercial application. Several major corporations have expressed interest in pursuing affordability measurement and prediction research.

N97-123 TITLE: Large-Area Infrared-Emissivity-Controlled Surfaces

OBJECTIVE: Develop low cost systems that allow dynamic control of the emissivity of large surfaces.

DESCRIPTION: The infrared energy absorbed, radiated, and reflected from objects is a direct function of the emissivity of the surface of the object. In a number of applications it is highly desirable to be able to control this absorbed, radiated, and reflected energy dynamically over time. This control is necessary to allow for changing environmental conditions. For navy applications, this control must be applied to large areas of surface ships that could extend to thousands of square meters and would be used to control the infrared signature of the ship. Due to the large surface area, the cost per square meter must be commensurate with normal ship construction costs. The method of control must be such that it can be implemented with electronic control signals. Candidate techniques for implementing an emissivity controlled surface system must be developed. The candidate systems shall allow for an electronic control signal to change the emissivity of the surface with a time response in the order of minutes. The candidate systems may be coatings that are applied over existing structures or may be structural components themselves. The candidate systems investigated must have the promise of being low cost when applied to large surface areas.

PHASE I: A theoretical/analytical investigations of and cost projections for surface concepts, as well as construction and testing of laboratory samples, are required to validate the analytical work.

PHASE II: Based on evaluation of candidate systems explored in phase I, develop large scale prototype demonstration articles of the most promising concepts. The demonstration articles shall demonstrate the technical feasibility of the concepts and the ability to manufacture and install large quantities at low cost.

PHASE III: Implement large scale manufacturing capability of emissivity controlled surfaces for military applications.

COMMERCIAL POTENTIAL: Low cost emissivity controlled surfaces have direct application in commercial as well as residential architecture. Such surfaces would be used to control heat absorption and reflection to allow for more efficient energy control of buildings that are subject to variations in climate and weather. These surfaces would also be used on vehicles to reduce air conditioning and heating energy requirements. This would be especially beneficial on all electric vehicles where electrical power for these functions can represent a significant portion of the overall energy requirements of the vehicle.

REFERENCES: Environmental Rersearch Institute of Michigan, "The Infrared Handbook revised edition", 3rd printing, 1989. Access to classified information may be required in phase II.

N97-124 TITLE: Vapor Phase Corrosion Inhibitors

OBJECTIVE: To synthesize and evaluate a new family of environmentally friendly vapor phase corrosion inhibitors for long range protection of naval enclosures with dissimilar materials, such as steel and aluminum.

DESCRIPTION: Vapor phase corrosion inhibitors (VCIs) are chemical compounds, when added in small concentrations to the environment, decrease or control the corrosion of the metal. The VCIs that are currently available in industry can at best control corrosion for a duration of about two years or less depending on the severity of the environment and metal-environment combination. There is a need in the Navy for providing corrosion control of empty steel cells in the future Advanced Double Hull commercial tankers and combatants over five plus years or more. Within steel cells there may be other metallic materials such as aluminum, stainless steel and copper-nickel alloys and therefore, vapor phase corrosion inhibitors should offer protection to multi-metals in steel cells enclosing electronic, pipeline, and other systems combining dissimilar materials.

PHASE I: Develop a family of new vapor phase corrosion inhibitors that are non-toxic and environmentally friendly, and evaluate their corrosion controlling efficiencies using common naval materials such as steel, aluminum and copper-nickel alloys in marine environments. The evaluations can be done using state-of-the art corrosion control methodologies in the laboratory.

PHASE II: Corrosion controlling efficiencies of VCIs can be tested and monitored in simulated systems that are exposed to natural marine environment.

PHASE III: Demonstrate the performance of successful vapor phase inhibitors selected from Phase I studies by monitoring the corrosion controlling efficiencies of selected shipboard systems (e.g., gun mounts and inverter cabinets) installed on AEGIS cruisers or other surface platforms representative of current and new ship classes.

COMMERCIAL POTENTIAL: The ship building industry can use the developed vapor phase corrosion inhibitors for protecting the steel cells on the Advance Double Hull commercial tankers from corrosion and to protect steel stock pilings from corrosion. These can also be used in oil and gas industry to protect the rigging tools from corrosion. Vapor phase corrosion inhibitors can be used to protect large civilian and military equipment during lay away and moth balling.

REFERENCES:
1. G. E. Fodor, in "Reviews on Corrosion Inhibitor Science and Technology," A. Raman and P. Labine, eds. (Houston, TX: NACE, 1993), p. II-16-1.
2. B. A. Miksic, in "Reviews on Corrosion Inhibitor Science and Technology," A. Raman and P. Labine, eds. (Houston, TX:NACE, 1993), p. II-17-1.
3. K. L. Vasanth, "Corrosion Inhibition in Naval Vessels," CORROSION/96 (Houston,TX:NACE 1996), paper # 233.

N97-125 TITLE: 3D Virtual Workbench

OBJECTIVE: Enable decision makers and engineering designers to visualize and interact in 3D with complex, computer-generated geometrical scenes ranging from 3D terrain populated with objects to large scale design systems.

DESCRIPTION: The Virtual Workbench paradigm for visualizing and interacting with 3D, computer-generated data has been shown to offer revolutionary capabilities. Individuals or groups utilize these displays to develop concepts and designs and to better understand multidimensional data sets. This effort would overcome limitations in the first generation of Virtual Workbenches; the most constraining of which is that multiple users see the scene only from the perspective of a single group leader who must perform all interactions presently.

PHASE I: Develop a Virtual Workbench in which two users observe different views of the scene. This system should allow each viewer to see images tailored to individual head movements and to each user's tasks using stereographic shuttered glasses at refresh rates high enough to eliminate flicker.

PHASE II: Develop a Virtual Workbench that enables four viewers to see individual images at flicker-free data rates and improve the resolution of the display over that provided by current projector technology. Development will include human factors analysis and performance assessment of the improved Workbench.

PHASE III: Produce virtual workbenchs for shipboard and/or headquarters use which are compact and effective in design, command and control, medicine, scientific analysis, and other relevant applications.

COMMERCIAL POTENTIAL: The system is applicable to any work environment requiring interaction with 3D, computer-generated images. Engineering design and medicine are two specific domains that would utilize this technology.

REFERENCE: Wolfgang Kruger, et al., "The Responsive Workbench", Computer, Vol. 28, No.7, July 1997.

N97-126 TITLE: Structural Health Monitoring Using Fiber-Optic Sensing

OBJECTIVE: Allow for the permanent installation and continuous operation of fiber-optic (structural) sensors on Navy ships so that structural health assessment may become an integral part of the entire ship sensor system package.

DESCRIPTION: The direct application of fiber optic technologies to the sensing and communication of structural responses is the primary objective. However, fiber optic sensors may also be used to measure a wide array of other important parameters, such as temperature or contaminant levels. All of these sensing technologies have a place on board modern Navy ships. Fiber optics in general is especially useful in wet, dirty, and electrically noisy environments. Fiber optic techniques can also be used to monitor flow, level, temperature, and vibration. Perimeter sensing and security have also been enhanced by the use of fiber optic and other light technologies (laser). Fiber optics, in general, offers a method of eliminating many mechanical sensors, electrically and magnetically sensitive electronics and wiring, and a number of other problems associated with intrusive sensing or sensing in difficult areas. The long term payoff of applying these technologies to Navy ships could be enormous, both financially and technologically. This structural health assessment system must be capable of interfacing with other automated systems currently being developed.

PHASE I: Demonstrate accuracy and applicability of fiber optic structural sensors during static or slowly varying structural tests.

PHASE II: Develop and/or assemble fiber optic based data acquisition system for data transmission and recording.

PHASE III: Develop fiber optic based data acquisition system utilizing fiber optic sensors and communications on board a Navy ship. Demonstrate system capability during at sea operations.

COMMERCIAL POTENTIAL: The hardware and/or complete system developed under this program can directly be used for commercial shipping (especially freighters and oil tankers), offshore structures, and land based civil engineering structures, such as bridges. There is also application for structures located in earthquake zones.

REFERENCES:

1. “Progress Towards the Development of Practical Fiber Bragg Grating Instrumentation Systems,” Kersey, A.D. et.al. , Fiber Optic Smart Structures Section, Naval Research Laboratory, Washington, D.C. 20375-5000, September 1996.
2. "Conceptual Plan for a Real Time Ship Monitoring and Structural Assessment System,” Kuny, J., Lewis, R., Dianora, M., Intelligent Ships Symposium II, American Society of Naval Engineers, Delaware Valley Section, 25 November 1996.

MARINE CORPS SYSTEMS COMMAND

N97-127 TITLE: AAAV Surf Zone Simulation Model

OBJECTIVE: To develop a physics-based, time-domain simulation model of the littoral environment suitable for use by the Advanced Amphibious Assault Vehicle (AAAV) program.

DESCRIPTION: A high fidelity simulation model of the littoral environment is needed to support verification of the AAAV design; to determine the performance impact of any modifications to the AAAV hull design proposed in the future; to facilitate development of training simulators for the AAAV and AAV; and to facilitate upgrading of the Landing Craft Air Cushion (LCAC) Full Mission Trainer. The model must be physics-based, time-domain, and of sufficient fidelity to support simulation of the handling and propulsion response of the AAAV to surging, spilling, and plunging surf effects as a function of sea state, sandbars and bottom characteristics, beach slope, tides, refraction, current, and wind. Boundary conditions are also needed to allow a seamless interface with existing dynamic open ocean simulation models. The model shall support simulation of AAAV operation during both planing and displacement states, and during transitions from one state to the other. The developed model shall be amenable to real-time computation, and shall not be unique to any specific computer or image generation hardware. The littoral model shall make use of best available cartographic/ geographic data such as the new Littoral Warfare Data (LWD) product from the Defense Mapping Agency.

PHASE I: Examine existing physics-based, time-domain models of the surf zone, and identify any deficiencies with respect to their capability to support simulation of the full dynamic response of the AAAV in the littoral environment. Determine the tests and analyses which need to be performed, and the data to be collected. Select a source or a methodology for developing the 3-D synthetic models of the AAAV and littoral environment features. Establish a process to validate the developed system.

PHASE II: Collect and analyze any supplemental wave modeling data identified in Phase I. Refine/extend/synthesize the AAAV physics-based surf model. Acquire or develop the 3-D synthetic representations of the AAAV and littoral features. Develop the AAAV vehicle dynamics model. All test data taken under the AAAV contract will be provided as GFI. Integrate the surf zone wave model and synthetic littoral environment with the AAAV vehicle dynamics model. Validate the complete system. Verify that the simulated AAAV response matches empirical performance data. Identify inherent limitations and inaccuracies of the model.

PHASE III: The validated models and software will be made available to the AAAV, AAV and LCAC simulator procurements, and made available to industry for development of commercial applications.

COMMERCIAL POTENTIAL: The proposed technology development has very broad application and unique potential for commercial simulations associated with dynamic surf.

N97-130 TITLE: Commercial Digital Camera Environmental Protection

OBJECTIVE: To provide low cost means of protecting a commercial, digital camera from harsh environments while allowing the camera to function.

DESCRIPTION: The goal of this SBIR is to produce a system which allows various lenses up to 500mm, in the environmental and physical conditions encountered by a Marine Expeditionary Force Reconnaissance Team (MEFRT). These include rain, blowing rain, salt fog, salt spray, blowing sand and dust, submersion to 32 feet and repeated shocks associated with man-packing and employment in the field for extended periods. Presently the MEFRT uses a Kodak DCS 420 digital camera but solution should be as generic as possible.

PHASE I: Show feasibility, System Design, Drawings, Specification, and Prototype. Cost estimate for Phase II.

PHASE II: Demonstrate system under severe environmental and employment conditions. Test report, design changes as needed, final System Configuration, Specification, nine pre-production items.

PHASE III: Product will become a production part of the Manpack Secondary Imagery Dissemination System (SIDS) and potentially the Tactical Photography (Tac-Photo) system. The small business will retain rights to the system and follow on designs, which it can market to the commercial sector for similar applications.

COMMERCIAL POTENTIAL: Numerous industries employ audio-visual equipment in adverse environmental conditions. Digital camera present numerous advantages over film cameras, yet environmental protection systems are currently unavailable for digital cameras. Emerging applications to law enforcement, surveying, environmental research, and exploration are easily envisioned.

REFERENCES: Manpack Secondary Imagery Dissemination System (SIDS) System Specification

N97-131 TITLE: Wide-Field-Of-View Anamorphic Lens

OBJECTIVE: Design, fabricate and evaluate an anamorphic optical system for an imaging infrared camera which maximizes viewing angle along a preferred axis (i.e., horizontal or vertical), and diminishes viewing angle along the orthogonal axis while maintaining an equal projected area per pixel.

DESCRIPTION: Video produced from imaging systems generally conform to an industry standard height to width aspect ratio, which allows recording, playback, and data analysis on generic equipment. Application specific aspect ratios using COTS hardware, can be implemented using an anamorphic optic which projects the distended scene on to the camera's detector array.

PHASE I: Perform theoretical design analysis of optical components and implement design for best image quality. Fabricate lens. Goal is 120□ to 150□ x 15□.

PHASE II: Implement engineering upgrade for isothermal focus from -20□ C to +40□ C without operator adjustment. Perform cost vs performance analysis for compact, low cost, lightweight designs, including replicated optics. Deliver Phase I isothermal design and cost optimized Phase II isothermal design hardware. PHASE III: Adapt optical design to alternative infrared and visible imaging systems.

COMMERCIAL POTENTIAL: In applications such as security, surveillance, and search and rescue, there is a long axis (e.g., a horizon, tall building, long street) which contains the information of interest and sky and foreground fractions (typified by conventional imaging systems) are undesirable. The optical design and lens elements resulting from this effort could be readily adapted to such purposes.

NAVAL AVIATION TEAM

N97-132 TITLE: Utilization of Fractal Based Models for Acoustic Signal Processing

OBJECTIVE: Develop and demonstrate the use of fractal based models for signal processing of non traditional signals with applications to detection and classification of one and two dimensional signals.

DESCRIPTION: A significant portion of conventional signal processing is based on the use and application of the Fast Fourier Transform (FFT) for those cases where the signal of interest is either narrow-band or wide-band in nature. Often, signal processing techniques are applied to the ubiquitous tasks of detection and classification; as such, the use of the FFT is connected to the signal energy content in the frequency domain. While the use of frequency localized signal energy is robust and practical it ignores any coherent or signal structure information contained in the measured data. Therefore, to exceed the detection and classification performance characteristics of conventional energy computations new processing techniques must be developed which exploit the signal's structure and coherent information beyond its energy content. One avenue of approach toward this end is to develop detection and classification processing based on the utilization of signal models.

This effort will focus on the use of fractal based models for both the one-dimensional (e.g., time-series) and two-dimensional (e.g., images) signal cases. Fractal models have enjoyed great success for modeling one- and two-dimensional signals with iterated function systems. In particular this is true for the signal compression problem. For this effort the contractor must first demonstrate which aspects of the fractal model are pertinent to the detection and classification problem and then develop an appropriate framework. Subsequently, the contractor must process data of interest to demonstrate the efficacy of the proposed methods. A conventional energy based detector will be used as a benchmark to evaluate the benefits of the new fractal techniques. For the one dimensional signal case receiver operating characteristic (ROC), curves will be generated and plotted on the same axes as the energy detector ROC curve so performance can be quickly evaluated.

PHASE I: Develop, describe, and implement the fractal techniques and compare their performance with classical methods of detection and classification. These methods must show significant improvements over present methods to go on to phase II.

PHASE II: Refine algorithms and perform extensive testing on real data. New algorithms must be rendered computationally efficient for aircraft usage. Preliminary plans will be made to implement the improved techniques on prototype systems/ platforms.

PHASE III: Install software algorithms in aircraft testbed for operational testing and evaluate algorithm performances. Subsequently, install algorithms on Beartrap aircraft for inflight testing.

COMMERCIAL POTENTIAL: As the techniques and methodologies developed herein are general in nature they may be applied to other signal processing problems. Other areas of application are: medical imaging, storage, and restoration; rapid image storage and retrieval on the information super highway; satellite/global terrain surveying; sea mapping; forward battle field information gathering; and other remote sensing, storage, and transmission systems.

N97-133 TITLE: COTS Real Time Unified Avionics Interconnect

OBJECTIVE: Adapt the emerging widely used COTS Serial Express interconnect protocol for use as a Unified Avionics Interconnect supporting optical backplanes and networks. Develop a prototype chip.

DESCRIPTION: Current military aircraft avionics use multiple interconnect types. For example, the F-22 uses five distinct avionics interconnects--three types in the backplane and two types between racks and sensors. In addition, both electrical and optical instantiations are used This multiplicity is expensive and causes performance degradation in bridging between interconnect types. Moreover, the interconnects are inadequate for emerging digital receiver technology (which will dramatically reduce avionics costs). The ideal interconnect would be a single unified protocol upwardly compatible with VME--preferably optically instantiated to provide high speed and low noise. Commercial interconnect technology (such as the Scalable Coherent Interface and Serial Express) is now available which runs at the necessary speed (8 Gbits/sec/link), achieves the low latency (through byte addressing) necessary for backplane usage, and supports optical backplane and network instantiations. However, none of the newly developed interconnects provide the features needed for real time (military and commercial) usage. The features needed include deterministic scheduling, fault tolerance, and (for the military) security. This effort will extend the commercial Serial Express interconnect protocol for high performance real time use.

PHASE I: Develop and simulate Serial Express high performance real time protocol enhancements including determinism, fault tolerance, and security. Perform the work in conjunction with, and with input from, the Serial Express industry working group which includes Sun, Cray (SGI), Intel, Apple, Lockheed, Northrop, Hughes, and others. Show VME P2 connector compatibility.

PHASE II: Design and prototype a real time Serial Express chip and standard cell design.

PHASE III. Transition the real time Serial Express chip and standard cell design to a commercial chip fabricator/ vendor (such as LSI Logic) for production and marketing.

COMMERCIAL POTENTIAL: Intel and Sun plan to use Serial Express in every personal computer/ workstation they build (millions). Several commercial computer companies are interested in extending their systems for real time usage. Two, in particular (Sun and Cray) want to extend Serial Express for high performance real time usage and would provide commercial transition.

REFERENCES:
1. IEEE 1596-1996 Scalable Coherent Interface
2. IEEE 1394.2 Serial Express (Draft)

N97-134 TITLE: Low-cost High-speed Optical Links for Advanced Avionics Data Networks

OBJECTIVE: To reduce the cost and increase the performance and reliability of high-performance interconnects used in advanced avionics data networks.

DESCRIPTION: Next generation avionics systems will require an order of magnitude increase in processing and networking capacity. In order to provide this capacity and at the same time reduce system component and development costs, a greater reliance is being placed on commercial off-the-shelf (COTS) protocols and components. One of the major impediments to the development of high-performance COTS-based networks is the cost of the networking components. This program is aimed at the development of a low-cost, high-performance fiber optic link for digital networks. The link should provide data microrates in the range of 4-8 Gb/s with latencies of less than 10 seconds at a unit cost of less than $1500 in quantity. The link should support a commercial high-performance protocol. In addition, a ruggedized version of the link should be capable of operating over the military temperature range.

PHASE I: Demonstrate feasibility of the interconnect by modeling and simulation of performance, cost, size, weight, and power of the link. Evaluate the temperature performance of the link. Evaluate and select COTS-based protocol chip.

PHASE II: Develop and demonstrate link prototype. Evaluate prototype for throughput, latency, size, weight, power dissipation, and performance over the military temperature range. The results of this evaluation should be used to verify Phase I modeling and simulation results and to estimate the unit cost of a commercial module.

PHASE III: In conjunction with a commercial optical module fabrication house, develop a low-cost integrated module suitable for both commercial and military applications.

COMMERCIAL POTENTIAL: The high cost of high-performance interconnects currently available represents a major limitation to their introduction into commercial computer networks. The development of low-cost high-speed networking components would represent a breakthrough in the field of commercial computer networks that would bring the benefits of high-end workstation clusters into the realm of economical desktop computing.

REFERENCES:
1. IEEE 1596-1996 Scalable Coherent Interface
2. IEEE 1394.2 Serial Express (Draft)
3. Joint Advanced Strike Technology Program, "Avionics Architecture Definition," Version 1.0, September 23, 1994.

N97-135 TITLE: Advanced Ship Motion Forecasting for Expanded Aviation Operations

OBJECTIVE: To develop a ship motion forecasting system for the purpose of allowing significant improvements in aircraft landing guidance, recovery and launch operations. This system will augment current and future aircraft launch and recovery systems on all seabased aviation platforms. It will increase the precision and safety of aircraft operations, especially in higher sea states.

DESCRIPTION: Aircraft/Ship Dynamic Interface is the interrelationships of an aircraftÕs dynamics and a shipÕs dynamics when the two are in close proximity to each other. Aircraft include both conventional take-off and landing (CTOL) and vertical take-off and landing (VTOL), both rotary wing and fixed wing, aircraft families. Ships include aircraft

carriers (CV/CVN), large deck amphibious assault ships (LHA/LHD) and air capable ships. Ship motion is a major contributor to the Aircraft/Ship Dynamic Interface problem. Ship motion is a critical operational parameter in the safe conduct of aircraft operations, which include; launch/take-off, approach, recovery/landing, rotor engage/disengage, inflight refueling, vertical replenishment, etc. Ocean inputs plus wind inputs act on the ship resulting in ship motion. Ocean inputs may include both surface and subsurface effects. Past attempts at developing ship motion forecasting schemes and lull predictors, primarily to support the AV-8B and other air vehicles with limited hover endurance, were unsuccessful. The technical challenge in addressing this problem lies in the fact that it is extremely difficult to determine ship response to energy inputs from the sea and wind. For this system to be useful it must be capable of accurately forecasting ship motion a minimum of 10 seconds in advance and must be robust enough to accommodate any aviation ship. It is desirable that the concept would use data from existing shipboard instruments.

PHASE I: Conduct a six month study which would consist of the following: a) an analysis of past work in this area; b) a determination and assessment of the relevant data that is currently available on Navy aviation ships; c) collecting and analyzing existing detailed data sets with respect to various forcing functions and ship response; and d) development of an advanced concept for forecasting ship motion a minimum of 10 seconds in advance. This concept shall include a performance model.

PHASE II: Develop a detailed design of the Ship Motion Forecasting System. The contractor shall also provide a breadboard system and demonstrate its performance using detailed real data sets. The system outputs shall be compatible with the current generation of Shipboard Visual Landing Aid Systems.

PHASE III: The contractor shall take the proven Ship Motion Forecasting System, harden it for shipboard use and conduct a demonstration and evaluation of the system onboard a Navy ship at sea. This demonstration will include providing accurate inputs to augment the Shipboard Visual Landing Aid System. This will be the transition of this system into NAVAIRSYSCOM PMA-251's Shipboard Aviation Systems Development Program.

COMMERCIAL POTENTIAL: The stated objective of this topic is to develop a ship motion forecasting system. This is one of several applications of this concept. Under this concept, the system would collect necessary sea/ship/platform data (be it from sensors currently available on the platform or utilizing additional sensors) and accurately forecast sea conditions thus allowing appropriate actions to be taken. This information is extremely valuable to a variety of ships including: passenger and auto ferries, oil tankers, cargo vessels, commercial pleasure cruise vessels, commercial fishing trawlers, seismic exploration and ocean mapping vessels and ocean cable laying ships. This information is also valuable to other platforms, such as offshore drilling rigs and weather forecasting and shoreline erosion research platforms.

For ship type platforms this SBIR concept will:

a) assist in plotting the shipÕs course to avoid undesirable sea conditions and corresponding ship response

b) assist in stabilizing the ship against severe motion during higher sea state conditions to ensure the survivability of the ship and to protect the shipÕs cargo which could include: passengers, automobiles, fuel, containers and other types of cargo

c) assist in the operation of rotary wing air vehicles from these platforms which would include: approach, landing, take-off, in-hover refueling and vertical replenishment

d) assist during ship-to-ship and ship-to-platform replenishment operations whether it be transferring supplies, cargo or personnel

e) assist during close maneuvering and or docking operations to avoid serious ship-to-ship and ship-to-dock impacts due to sea conditions

For more stationary type platforms this SBIR concept will:

a) assist in preserving the integrity and safety of the various platforms

b) provide a measurement and collection capability for acquiring sea impact data to be used in design of future platforms and for shoreline erosion studies

c) assist in aiding the operations decisions and load optimization for off-shore oil drilling platforms

N97-136 TITLE: Advanced Targeting through Decision Aids

OBJECTIVE: Perform exploratory research to identify innovative information processing architectures that can advance current interactive, computerized decision aids into learning and evolving decision making systems in support of Reconnaissance, Surveillance, and Target Acquisition missions.

DESCRIPTION: The dynamic nature of the battlefield requires near-real-time information to maintain the commander's awareness of the situation. Computer-based decision aids support portions of situational awareness by providing target movement prediction, threat analysis, vehicle modeling, imagery display and analysis, etc. Each of these decision aids requires a trained and experienced operator to maximize the utility of the decision aid. The appropriate level of training and experience is not always possible in preparation for, or during, an armed conflict. Further, each decision aid may yield an output product that is inconsistent with the products of the other decision aids. This inconsistency requires iterations in the planning cycle and/or yields conflicting mission data. A significant improvement in operational effectiveness would be provided by an information

processing architecture with the following minimum capabilities: (1) Provide a framework which enables existing decision aids to be plugged in to a single system, (2) Standardize the assumptions and find a common baseline for the output of each decision aid, (3) Provide a software agent to watch experienced operators use each decision aid and learn appropriate actions for a variety of situations, for both the individual decision aids and the planning process as a whole, (4) Watch less-experienced operators and provide immediate feedback on their actions and inactions for the current situation, and (5) Perform in a completely autonomous mode whereby the software is able to make a decision based on inputs to the various decision aids and the current situation (e.g., day four of a conflict, specific regional tendencies, night operations, etc.). Artificial intelligence techniques have not shown sufficient maturity to be used as decision makers or decision quality control in armed conflict. However, recent biologically inspired developments in the field of computer science have shown preliminary advances in learning and evolving, including genetic algorithms, artificial life, cellular automata, and a variety of hybrid technologies. The focus of the Phase I effort is to define an "intelligent" architecture that addresses the learning, teaching, and evolving nature of an automated decision making system. The baseline for this effort is the mobile and relocatable target search problem. The system should be able to perform in near real-time. A prototype implementation should be developed in C or C++ and should be able to run on equipment consistent with Navy combatant computer architectures.

PHASE I: Conduct an analysis of the operator's planning process and perform exploratory research of candidate technologies for developing an information processing architecture for an advanced targeting system. Demonstrate results as part of a prototype implementation.

PHASE II: Expand the prototype system to demonstrate the architecture; the system should be able to learn from experienced operators (at both the individual decision aid and the planning process levels), and provide immediate feedback on the actions and inactions of less-experienced operators.

PHASE III: Expand the Phase II prototype into an operational system that standardizes the assumptions and provides consistent output for each decision aid, and is able to perform in a completely autonomous decision making mode.

COMMERCIAL POTENTIAL: Training systems, Search and rescue operations, counter-drug operations, police surveillance operations.

REFERENCES:

1. Navy combatant computer architecture. (http://www.nswc.navy.mil/TAC-4/)
2. Common Operating Environment. (http://spider.osfl.disa.mil/dii/)
3. Holland, J. H. "Adaptations in Natural and Artificial Systems", MIT Press, 1992.
4. WWW.NSWC.NAVY.MIL/TD/AC/SBIR

N97-138 TITLE: Interference Mitigation in Night Vision Goggle (NVG) Systems

OBJECTIVE: Develop a technique or set of techniques to mitigate interference effects in NVGs.

DESCRIPTION: Current GEN III NVG systems provide a tremendous advantage to naval aircrew during covert night operations. However, these systems are susceptible to serious performance degradations from external interference sources. Examples of interference effects include blooming due to bright objects in the field of view, dazzling/blinding due to intentional/unintentional laser interference, and undesired Auto-Brilliance Control initiation due to one or more high energy source(s) leading to decreased gain and loss of image contrast. In some instances the performance degradation caused by the interference can prevent the successful completion of a mission. To combat these possibilities, the Navy is interested in developing a compact, lightweight device to be used with existing GEN III NVG's that will mitigate the susceptibility to interference. Preference will be given to solutions that can be retrofit into existing NVG systems, through alternative system designs will not be ruled out if they are shown to reduce the size and weight of the end product.

PHASE I: Design and analyze an optical device to mitigate interference effects in GEN III NVG. Build and test a proof-of concept device demonstrating the critical technologies. Make specific recommendations regarding which NVG systems are suitable for use with the device. Modeling and/or experimental data will be required to identify any performance degradation due to installation of the device into an NVG system.

PHASE II: Using modeling and hardware from Phase I, and additional hardware as necessary, evaluate the combined NVG/interference mitigation system to identify techniques to optimize performance. Build a first-generation device and demonstrate/evaluate its operation/performance with a GEN III NVG system.

PHASE III: Phase III will include both military and commercial applications for NVG interference mitigation. Based on the results of the Phase II effort, develop production representative interference mitigation devices along with manufacturer test data for verification/validation by the appropriate military and commercial evaluation organizations. Primary military applications include NVG improvements for F/A-18, AV-8B, and F-14 aircraft for use in night operations. Primary commercial applications include police and private aircraft surveillance activities.

COMMERCIAL POTENTIAL: Night Vision Devices are currently used by law enforcement agencies, news agencies, boaters, and others. This commercial demand is increasing rapidly and the requirement to mitigate interference sources will grow as the

utilization increases. The same technology used to mitigate interference in Navy NVG will be equally effective in mitigating interference in commercial NVGs. The ability to expand the technology into various market needs will provide low cost solutions to overall development and production.

N97-139 TITLE: Advanced signal processing and Display Concepts for airborne Active ASW Systems

OBJECTIVE: Use advanced signal processing and display techniques to enhance performance of future airborne active acoustic ASW systems in high clutter environments.

DESCRIPTION: Advanced low frequency coherent active systems will present the acoustic operator with excessive workload if traditional active acoustic signal processing and display methods are used. Planned improvements in sensors and avionics will allow for the use of advanced waveforms, signal processing, display, and data fusion. System performance will depend upon the application of such advanced concepts to enhance detection performance and reduce false alerts to an acceptable level, especially in the adverse environments of projected areas of operation. This SBIR effort will address the best use of sensor improvements to meet the required airborne ASW system performance.

PHASE I: Provide innovative signal processing, classification and display concepts which best capitalize on the advanced active sensors and avionics improvements. The concepts must demonstrate sufficient performance metrics of target detection and false alarm probabilities to add value to the planned airborne ASW systems, as well as feasible system implementation.

PHASE II: Develop, test and operationally demonstrate a working prototype of the techniques investigated under the Phase I SBIR effort, using actual Government furnished input data. The prototype system must be consistent with transition of the concepts to fleet systems.

PHASE III: Implement the systems concepts and signal processing algorithms in a fleet ASW platform configuration.

COMMERCIAL POTENTIAL: The advanced signal and data processing techniques developed under this task can be applied to commercial sonar systems.

NAVAL FACILITIES ENGINEERING CENTER

N97-140 TITLE: Rapid Cargo Throughput for Sea Based Logistics

OBJECTIVE: Develop logistics technologies to enable the Marine Corps to perform SEA BASED LOGISTICS from various floating platform configurations. Sea based logistics is the performance of essential combat service support (CSS) functions from a floating logistics platform.

DESCRIPTION: Winding down of the Cold War led the Navy and Marine Corps to change their operational doctrine from seeking worldwide, blue-water superiority to power projection in littoral areas. For its part in this new strategy, the Marine Corps developed a new doctrine referred to as Operational Maneuver from the Sea (OMFTS), which stresses the application of firepower and maneuver warfare. Much of the emphasis on OMFTS has been on high technology in the areas of firepower and maneuver, overshadowing the vital elements of combat service support (CSS). Since OMFTS changes the way combat power is deployed, traditional amphibious logistics ashore will not meet the unique logistics demands of OMFTS. Sea based logistics (SBL) has been proposed as the solution to provide combat service for OMFTS operations. Logistics support for the Marine Corps fighting forces ashore, the Marine Air-Ground Task Force (MAGTF), is called Combat Service Support (CSS). CSS provides the essential capabilities, functions, activities, and tasks necessary to sustain all elements of operating forces in theater at all levels of warfare. Traditionally, CSS has been performed from a base established ashore. The most prominent feature of SBL is that it supports combat units directly from ships or other floating platforms offshore instead of building a logistic infrastructure ashore. As envisioned at present airlift in various forms (helicopter, VSTOL, etc.) will be the dominant transport mode of SBL.

It is generally held that the application of SBL to provide the essential support for OMFTS is possible only in limited situations today. SBL is constrained by equipment limitations, traditional methods of logistics delivery and packaging, and configuration and outfitting of existing potential logistics bases (mainly ships). Today's amphibious shipping is configured for "combat loading" in which the ship's cargo is fully unloaded via the "last in first out" method. The success or failure of an OMFTS mission is determined by how well supplies, equipment, and personnel move through the logistic system.

It is the intent of this exploratory development effort to identify new technologies, equipment, and procedures that can contribute toward a SBL capability necessary to support OMFTS at all force levels and over the range of Marine Corps missions. Assume that a Seabase will consist of a set of amphibious ships augmented by merchant ships of the container break/bulk or Roll On/Roll Off variety. The problem to be addressed is the movement of cargo/containers from a confined area to the beach in a rapid manner.

Proposals may be for complete new cargo handling systems to a single component that has significant potential to enhance today's capability to perform sea based logistics. The intent is to award one contract for this topic; however, additional contracts may be awarded based on the merit of proposals received.

PHASE I: Develop a concept and preliminary design for the proposed system/component. A wide range of proposals will be considered for award in Phase I of this topic. Cargo handling equipment/methods, selective cargo offload, ISO container unstuffing/stuffing methods, and airlift deployment methods aboard ships/platforms are of particular interest.

PHASE II: Validate the proposed design. Advance the preliminary design to the stage that a prototype can be fabricated. Demonstrate the capability of the design by testing the prototype in a mockup or in an available shipboard environment.

PHASE III: Complete the design package and prepare a performance type specification for use in commercial and military applications. The new system/component/procedure will be considered for use in the next generation sea base ship/platform.

COMMERCIAL POTENTIAL: The system or component(s) has potential for use in all inter-modal facets of the cargo handling industry. Shipboard cargo handling and management systems have potential to improve the way commercial maritime cargo operates today. Methods to unstuff/stuff ISO containers could have immediate commercial application throughout the cargo handling industry.

REFERENCES:

1. Navy Science and Technology Round Table for 1996
2. Marine Corps Expeditionary Warfare Science and Technology Round Table for 1996.
3. Committee on "The Navy and Marine Corps in Regional Conflict in the 21 st Century " by the Naval Studies Board.
4. "Operational Maneuver From the Sea," Marine Corps Gazette, June 1996.

N97-141 TITLE: Relocatable Crane Technology for Use on Floating Platforms

OBJECTIVE: Develop the technology or mechanisms needed that will allow relocatable cranes to be used on floating platforms subject to wave-induced motions in open ocean conditions.

DESCRIPTION: Existing technology for relocatable cranes, such as that used to move and secure rail-mounted portal-type cranes, is insufficient to withstand the dynamic loads imposed by the wave-induced motions of floating platforms. The development of suitable technology or mechanisms that would permit rail-mounted cranes to be used on floating platforms exposed to open-ocean conditions, or the development of a new concept for relocatable cranes that would function under these conditions is sought.

PHASE I: Develop a concept for either a mechanism that will permit the use of rail-mounted cranes on floating platforms exposed to open ocean conditions, or a concept for a new type of relocatable crane that will function under these conditions. Complete a feasibility assessment of the concept, addressing all environmental and operational load conditions.

PHASE II: Develop a conceptual design for the concept. Demonstrate the ability of the concept to meet the environmental and operational load requirements through model testing or full-scale subsystem or sub-component testing.

PHASE III: Develop a complete preliminary design and specification for the concept suitable for prototype fabrication.

COMMERCIAL POTENTIAL: This technology or mechanism would be useful to the offshore construction and sealift industries. The development of a suitable concept could lead to more versatile barge cranes used in offshore construction practice. The incorporation of this technology into commercial sealift ships could provide a greatly enhanced self-sustainment capability, allowing ship cranes to access a higher percentage, if not all, of their shipboard cargo spaces and allow the direct transfer to shore-based facilities. This would speed both offloading and loading operations.

N97-142 TITLE: Integrated Control of A Powered Causeway Ferry

OBJECTIVE: Develop and demonstrate a commercially viable integrated, intuitive operator friendly controller that will increase maneuverability of causeway ferries while reducing the need for highly skilled operators. The system shall simultaneously control from two to four fully azimuthing thrusters. It is also desirable that the control system be adaptable to a land-based simulator (trainer).

DESCRIPTION: The existing Navy causeway ferries, which are 5-ft deep by 21-ft wide and vary in length from 90- to 360-ft in 90-ft increments, are not fully capable of maneuvering alongside ships and piers during a Logistics Over The Shore (LOTS) operation in higher sea states. This deficiency is primarily due to the fact that only two thrusters are available and both are

located in the stern of the causeway ferry. Each thruster currently has separate controls for engine rpm and nozzle direction. The Navy is currently developing more capable causeway ferries that will be able to operate in sea state 3(SS3). This system makes use of larger causeway sections, each 8-ft deep by 24-ft wide by 120-ft long, that are assembled into ferries 120-, 240- and 360-ft long. To provide better maneuver capability, bow thrusters can be used. For a new causeway ferry that utilizes two bow and two stern thrusters, eight controls (engine rpm and nozzle direction for each thruster) would be required. Because this number of controls is too many for Navy personnel with limited training and experience to handle, a simplified control system is required. To meet this requirement, the Navy wishes to develop an intuitive joy stick control system. The system would control multiple, fully azimuthing waterjets capable of producing approximately 6,000 pounds thrust each. Individual as well as simultaneous vector and rotational control of the causeway ferry is required. Net thrust during these maneuvers should be optimized for maximum efficiency. The control system would also have to compensate for thruster causalities. The end product of this development should result in a control system that allows either loaded or unloaded causeway ferries to be safely maneuvered underway as well as during approach and moor operations alongside either a ship or pier to receive and/or discharge cargo.

PHASE I: Develop a system design for a integrated, intuitive control system for causeway ferries. This system must be adaptive, operator friendly , i.e. easy to use with control logic that addresses use of a varying number of thrusters, and the varying length and displacement of causeway ferry configurations. The system design should also consider the option of being upgraded to a dynamic positioning system at a future date.

PHASE II: Validate system design of a integrated, intuitive controller. Develop integrated, intuitive control hardware and logic (software). Demonstrate aboard a Government provided causeway ferry. Document demonstration results and address system design deficiencies.

PHASE III: Prepare system performance specification for use in commercial and military applications. Results of successful development will be considered in new causeway ferry acquisition or retrofitted to existing hardware assets.

COMMERCIAL POTENTIAL: This system provides a new concept to the marine industry that could be used aboard large barge trains with multiple tugs to integrate and optimize their control. This system could meet the stringent maneuvering environment of river navigation for large barge trains.

N97-143 TITLE: Multiple Access RF Communication Protocol

OBJECTIVE: Develop Radio Frequency Identification (RFID) communications protocols that can be integrated with off-the-shelf systems and will allow the collection of 50 or more moving RF transmitters in a portal application without requiring the transmitters to remain in the interrogation area for more than 1 second.

DESCRIPTION: Existing RFID systems operate as either batch or portal collection systems. In a batch collection system, RF transmitters packaged as RF tags are collected in a wide area. In a portal system, RF tags are collected as they pass an entry/exit way or "portal". Current portal RFID systems, whether active or passive, have several inherent limitations. Most systems require tags to remain stationary for a finite amount of time when multiple tags must be read at once. When several tags must past a portal at one time and they do not pause for interrogation, only a percentage of the tags will be acquired. The capability to read multiple tags as they pass a portal is needed in developing a system which can track items going in and out of containers, warehouse bins, etc.

PHASE I: Develop new RF communications protocols to handle the multiple access of 50 or more tags as they simultaneously pass through a portal at a high rate of speed. This protocol should be verified through a demonstration using appropriate hardware. Although it will be the developer's responsibility to identify the appropriate hardware to provide a true "portal" interrogation, the prototype system should be flexible enough to allow it to adapt to platforms being used by the Navy.

PHASE II: Integrate the protocol with RFID systems being developed by the Navy and demonstrate several prototypes of the system with this protocol in place. This demonstration will include all appropriate hardware and software to comprise a complete RFID solution.

PHASE III: Provide turnkey system for field testing at Navy installations and field exercises.

COMMERCIAL POTENTIAL: The commercial potential of this system spans several industries. It is applicable wherever an accounting of supplies is required. This includes applications in warehousing, transportation, supply, disaster relief, mail delivery, etc.

N97-144 TITLE: Inflatable Boat Propulsion System

OBJECTIVE: Propel a 15-foot rubber inflatable boat in the open ocean loaded with 2000 pounds at 18 knots in sea state three. Provide responsive propulsion in transitioning the surf zone and during slow speed maneuvers.

DESCRIPTION: The propulsion system must be safe for people in the water near the boat. The propulsion system shall be light weight with an objective of less than 140 pounds. It is desired that the system be capable of being submersed to a minimum

depth of 75 feet of sea water for a minimum of 12 hours with preparation. After submersion the system shall be started without tools in 3-6 minutes and the system shall function properly. The system is desired to have a fuel economy of 3.5 NM per gallon of fuel. The system is desired to have a mean time to repair of 4 hours and a mean time between failures of 200 hours.

PHASE I: Develop a system design for a Inflatable boat propulsion system. The design must meet the requirements listed in the description. The propulsion concept shall be demonstrated.

PHASE II: Develop, fabricate, and test prototype. The prototype will be tested against the existing MARS engine and other competing systems to determine the optimum system to meet fleet requirements.

PHASE III: Transition prototype designs into Marine Corps inventory.

COMMERCIAL POTENTIAL: Provides safe, strong, and trustworthy propulsion system for small marine craft.

REFERENCES: Operational Requirements Document for Inflatable boat Propulsion System

N97-145 TITLE: SPACE-BASED ASSET TRACKING AND INVENTORY SYSTEM

OBJECTIVE: Utilize existing technology to develop a space-based tracking and inventory system for tactical military operations. This effort will leverage technology from existing DARPA R&D programs, customizing the equipment for use by Marine Air-Ground Task Forces and naval support forces (NSF).

DESCRIPTION: The location and status of tactical ground forces and their supplies is a serious problem for the MAGTF and NSF commander. Digital equipment now exists which, if properly integrated with naval communications and satellite systems, could provide three critical services – unit location, message traffic and tracking of supplies. Initiatives by DARPA, the Army's Dismounted Infantry Battle Lab, Torrey Science and SRI Corporations have tested a prototype system. However, this effort has not addressed specific Marine Corps or Naval Support Force concerns. These concerns include: masking of relay spacecraft by terrain; viability of flat screen technology for field use; software display symbology; utilization of ground and spacecraft transmitters for OTH fleet operations; integration into the current amphibious C^4I systems; and linkage of supply data via RF Identification Tags.

PHASE I: In conjunction with initiatives by DoD and private agencies, investigate the adaptability of the present equipment for use by Marine Corps and naval support forces. Analyze data from Exercises Warrior Focus (Fort Polk - Nov95) and Hunter Warrior (MCAGCC - Feb97) to address the above concerns. Conduct studies of: system integration with Marine and naval communications; range versus power for satellite uplink; terrain masking; advantages of GPS or Doppler navigation methods; modulation techniques and digital polling; viability of flat screen technology for field use.

PHASE II: Develop, assemble and demonstrate a system usable by Marine ground forces for two-way digital data relay between naval ships and ground forces. Equipment should be capable of: tracking and displaying location of multiple units; relay of typed messages; acceptance and linkage of RF tag data; transmission of map backgrounds and unit locations (using map symbology). The system must reliably link shipboard command centers (operating over-the-horizon) to units ashore which may be masked by intervening terrain. The demonstration must involve two-way ship-to-shore communications but may utilize non-encrypted line-of-sight transmissions or relay towers.. Components need not be ruggedized for tactical usage.

PHASE III: Demonstrate a deployable system capable of reliable digital linkage (BER 10^{-6}) to low-earth orbiting relay spacecraft. Improve the design for: rugged usage; all-weather conditions; reduced system maintenance and weight; improved reliability and service life. Data transmission must be encrypted and provide two-way real-time color displays of mapping backgrounds, unit designators and message traffic. Field equipment must be battery operable and man-portable. The radio frequency identification tags must reliably report from field interrogators to a shipboard control center.

COMMERCIAL POTENTIAL: This sort of data relay system has obvious applications for industry or other government uses. Examples include: business teleconferencing of charts, maps or graphics products, automated tracking and inventory of vehicles, vessels and premium cargo for the shipping industry; tracking and message functions for law enforcement, fire, fishing, forestry, hazardous material agencies, etc.

REFERENCES: Memorandum DCS:ESC-32 of 3 September, 1996. Contact Mr. Synnes for copies at (805) 982-1020.

NAVAL SUPPLY SYSTEMS COMMAND

N97-146 TITLE: Environmentally-Safe, Disposable Food Service Utensils

OBJECTIVE: The purpose of this work is to develop and demonstrate food service utensils (forks, knives, spoons, plates, cups, trays, "clamshells") that can be safely disposed of in marine environments and land environments. Military operations aboard ship require the use of disposable food service utensils when dishwashers are inoperative or when fresh water is unavailable for washing. Often meals are taken away from the mess as in the case of food consumed at watch stations. Disposable utensils are preferred for take-away meals because of the problems of storing and returning permanent utensils that are food-contaminated. Plastic utensils are widely available but international treaty precludes disposal of plastics at sea. Plastic utensils degrade so slowly that they are environmentally objectionable. A need exists for food service utensils that quickly break down when exposed to natural environments and pose no toxic hazard to marine life.

PHASE I: In Phase I, the contractor will demonstrate that food service utensils can be fabricated from combinations of natural materials that will quickly break down and which are environmentally-safe.

PHASE II: In Phase II, refine materials formulations and processing techniques so that test quantities of food service utensils can be fabricated. The contractor will subject the utensils to degradation testing. The contractor will subject the utensils to laboratory and field testing to demonstrate that they can fulfill their intended purpose with a broad range of foods (e.g., hot liquids).

PHASE III: In Phase III, the contractor will work with the restaurant industry to transition the products to the commercial marketplace.

COMMERCIAL POTENTIAL: Fast food restaurants such as McDonalds are intensely sensitive to their environmental image. Whenever possible, the large restaurant chains widely promote their initiatives to move toward environmentally-safe, disposable utensils and packaging. Materials that perform successfully in military applications would be attractive for hamburger clamshells and other food serving and consumption utensils.

BUREAU of NAVAL PERSONNEL

N97-147 TITLE: A Tool to Optimize the Predictive Accuracy of Personnel Selection and Classification Instruments

OBJECTIVE: To develop a methodology and tool to obtain a military or civilian applicant population personnel selection instrument intercorrelation matrix that will allow an accurate assessment of the most valid selection instrument and adjust for the effects of any prescreen or multiple hurdle testing.

DESCRIPTION: The Navy uses the Armed Services Vocational Aptitude Battery (ASVAB) as both a selection and classification instrument. The Armed Forces Qualification Test (AFQT), comprised of math and verbal ASVAB tests, is used for service accession. Various combinations of from two to four ASVAB tests (there are 10 tests measuring various aptitudes, skills, and knowledge) are used to classify accessions into occupational specialties. The Navy has eleven classification composites. Assessing the relative predictive accuracy of the composites is nontrivial; an increase in the predictive accuracy of .05 correlation points (validity) for a particular classification composite over all others has been shown by economists to save millions of dollars annually in reduced school attrition. Because school performance measures are only known for students who have completed training, it is impossible to specify the applicant population validates for the various classification composites.
This information is needed, because it is from the applicant population that the Navy will make future school assignments and school performance predictions. Further, the validity of the particular operational composite that is used for school selection is disproportionately attenuated (restricted) relative to other candidate composites due to the curtailment effect on the range of test scores occurring from selection at the school's minimum qualifying score. That is, test score variance is directly related to validity magnitude. Although there is a statistically based procedure to estimate the applicant population classification composite validates of interest, the theory and procedure do not take into account pre-selection screens, such as the Enlisted Screening Test (EST) that is administered at the Recruiting Stations. The impact of these and other prescreens, or multiple hurdle/sequential screening in the case of civilian personnel testing, diminishes the capability of assessing the relative predictive accuracy of personnel selection instruments.

PHASE I: Design a methodology to determine an unbiased Navy applicant or civilian personnel selection instrument intercorrelation matrix.

PHASE II: Develop, test, and demonstrate the procedures used in Phase I.

PHASE III: Produce software suitable for civilian as well as military use.

COMMERCIAL POTENTIAL: Industrial use generalizes to all organizations and Federal agencies that systematically administer personnel selection and placement tests in a sequential, multiple hurdle situation.

REFERENCES:

1. Held, J. D., and Foley, P. P., (1994). Explanations for Accuracy of the General Multivariate Formulas in Correcting for Range Restriction. Applied Psychological Measurement, 18, pp. 355-367.
2. Lawley, D. (1943-44). A Note on Karl Pearson's Selection Formula. Proceedings of the Royal Society of Edinburgh, 62, (Section A), 29-30.3. Linn, R. L. (1968). Range Restriction Problems in the Use of Self-Selected Groups for Test Validation. Psychological Bulletin, 69, 69-73.

N97-148 TITLE: Diagnostic Cognitive Task Analysis of Team and Multi-team Training

OBJECTIVE: Enable the trainers of teams and multi-teams to develop tests, keyed to existing procedural training, that can diagnose knowledge and skill weaknesses to be overcome by completing one or more training modules.

DESCRIPTION: Cognitive task analysis is a procedure used to develop the knowledge base to be incorporated into new instructional design. But it also has been applied to existing training material to produce improved, knowledge-engineered training. This effort will use cognitive analysis techniques to identify knowledge and skill elements in existing modules of training designed to improve the performance of teams and multi-teams. It will develop procedures to adapt and apply the techniques in the form of a diagnostic test keyed to different parts of the training.

PHASE I: Partition an example of existing team training into modules and apply cognitive task analysis, identifying knowledge and skill elements for each module. Develop procedures to convert the techniques used in eliciting the knowledge and skill information during the cognitive task analysis into a diagnostic test instrument that can be administered to team members.

PHASE II: Apply the cognitive task analysis techniques and test development procedures to training material for two teams that have different jobs. Categorize the team tasks that are being tested, and validate the test development procedures for each task category by administering the diagnostic test before and after team training.

PHASE III: Identify test development procedures best suited for different categories of team tasks. Prepare a diagnostic test development guide for use with existing team training that is based on cognitive task analysis techniques.

COMMERCIAL POTENTIAL: A guide to developing diagnostic tests based on the cognitive task analysis of existing training can be used in any work environment, civilian or military, that provides practice or exercises for teams or multi-teams.

REFERENCES:
1. DuBois, D., and Shalin, V. L. (1995) Adapting cognitive methods to real-world objectives: An application to job knowledge testing. In P. D.Nichols, S. F. Chipman, and R. L. Brennan (Eds.), *Cognitively Diagnostic Assessment* (pp. 189-220). Hillsdale, NJ: Erlbaum
2. Gordon, S. E. (1993) Conceptual graph analysis: Knowledge acquisition for instructional design. *Human Factors, 35(3),* 459-481.
3. Means, B., and Gott, S. P. (1988) Cognitive task analysis as a basis for tutor development: Articulating abstract knowledge representations. In J. Psotka, L. D. Massey, and S. A. Mutter (Eds.), *Intelligent tutoring systems: Lessons learned* (pp. 35-57). Hillsdale, NJ: Erlbaum
4. Randel, J. M., Pugh, H. L., and Wyman, B. G. *Methods for conducting cognitive task analysis for a decision making task* (NPRDC-TN-96-10). San Diego: Navy Personnel Research and Development Center.

N97-149 TITLE: Diagnostic Tool for Reengineering Team Training Using Cognitive and Team Process Analyses

OBJECTIVE: Conduct cognitive task analysis and team process analysis of complex, team-oriented tasks (e.g., combat information centers, engineering, air traffic control, nuclear plant). Develop multi-media technology for team performance diagnosis and improved training.

DESCRIPTION: Cognitive task analysis has been used successfully to improve medical diagnosis and land navigation skills of individuals. Team process analysis has been successful in reengineering businesses and organizations. This proposal applies these technologies to teams working with complex equipment systems in a Navy setting.

PHASE I: Perform cognitive task analysis and team process analysis on tasks currently performed in the Combat Information Center (CIC) or an engineering department aboard ship. These functions represent complex human-machine systems requiring technical knowledge, critical decision making, and coordination of team efforts. The analyses will focus on describing knowledge representation (strategic knowledge and meta-cognition), decision heuristics, and task coordination.

PHASE II: Develop and test a prototype multi-media technology for diagnosing team performance in a CIC or engineering environment. The multi-media deliverable will incorporate the results of the cognitive and team process analyses in Phase I. Based on the cognitive and team process analyses, the multi-media product will diagnose strengths and deficiencies in

knowledge, decision quality, and team work. These results can be used as a diagnostic tool to improve existing training and develop new training methods.

PHASE III: Prepare easy-to-use multi-media package for use by Navy personnel in diagnosing team members performing complex CIC or engineering tasks during fleet training. Diagnostic results will be recorded and used as feedback for improved school house and operational training.

COMMERCIAL POTENTIAL: The technology can be adapted for civilian use with any team-oriented human-machine system (e.g., air traffic control, nuclear plants).

REFERENCES:
1. DuBois, D., & Shalin, V. L. (1955). Adapting cognitive methods to real-world objectives: An application to job knowledge testing. In P. D. Nichols, S. F. Chipman, and R. L. Brennan (Eds.), Cognitive Diagnostic Assessment (pp. 189-220). Hillsdale, NJ: Erlbaum.
2. Hammer, M. (1993). Reengineering work: Don't automate, obliterate. Harvard Business Review. March-April, 6-11.
3. Randel, J. M., Pugh, H. L., & Wyman, B. G. Methods for conducting cognitive task analysis for a decision making task (NPRDC-TN-96-10). San Diego: Navy Personnel Research and Development Center.

SPACE and NAVAL WARFARE SYSTEMS COMMAND

N97-150 TITLE: Target Imagery Classification System

OBJECTIVE: A methodology is needed for automated target classification based on Inverse Synthetic Aperture Radar (ISAR) images. The methodology used for classification must use target attributes that are transferable in alphanumeric form by message (e.g. spatial features). The methodology developed should support simple operator interpretation of imagery data and a reliable means for parametric based decision making by computer.

DESCRIPTION: The requirement exists for automated approaches for classification of surface and submarine targets. Navy Over-The-Horizon (OTH) Gold message sets provide a means to generate and distribute target parametric descriptions. Acoustic and electro-magnetic data sets exist (i.e. SIGNA and RADB sets) and can be used for classification by matching with a priori target databases (e.g. frequency lines). A new message set (i.e. ISAR) needs to be developed to similarly support classification based on spatial information. A responsive proposal will demonstrate prior work in subject area and an approach for obtaining government or industry sensor data sets.

PHASE I: Outline a consistent methodology for the finger printing of surface ship and submarine targets based on ISAR imagery. Identify measures of performance (MOPÕs) and metrology for assessment of classification algorithms used. Prepare final report that provides the justification and analysis that supports the methodology presented and documents the MOP's.

PHASE II: Develop a target database based on imagery derived attributes from data sources provided by government or industry. Define a prototype imagery message set with sensor attribute fields, develop test message files, and test classification algorithms. Refine algorithms and/or prototype message set formats as needed. Initial target database will be one commercial available such as Janes. Prepare final report.

PHASE III: Develop a prototype automatic target recognition (ATR) system. Investigate use of automated classification algorithms to interpret other sensor imagery sources (e.g. ASAR, FLIR, etc.) and explore potential message sets as appropriate. Show transition path for technology to future information systems such as Joint Maritime Command Information System (JMCIS) and other maritime systems.

COMMERCIAL POTENTIAL: Advanced technology to fuse imagery information for object identification is applicable to security systems. The automated interpretation of imagery information supports intelligent transport systems such as air traffic control and highway traffic routing and safety systems for automobiles, aircraft, and ships. The automated interpretation of imagery sensor information may be applied to the data from the NOAA satellites for other government and commercial business opportunities.

REFERENCES: These are unclassified references that provide a general overview of topic.
1. Operational Specification For OTH Targeting Gold (Rev B)
2. McCune, Brian P., and Robert J. Drazovich, ÒRadar With Sight and KnowledgeÓ, Defense Electronics, Vol. 15, August 1983, pp. 80-84, 87, 90, 93-96.

N97-151 TITLE: Interactive Audio Human System Interface

OBJECTIVE: Provide Naval warfighters, whether stationary or mobile, the ability to increase human productivity and responsiveness by providing the capability to access data from information systems through an Interactive Audio (IA) Human-System Interface (HSI) while simultaneously performing visually-oriented activities such as operating vehicles, ships, aircraft, equipment, and weapons.

DESCRIPTION: The importance of timely information in warfare is ever increasing. IA HSI capability facilitates the simultaneous access to information. It complements or provides an alternative to the visually-oriented HSIs (e.g., keyboards, video displays) characteristic of today's information systems. Using a basic set of commands, activated by voice or touch, users can interact with the systems to access information. The desired information will be available to the users in different audio formats depending on the information type. This effort should use existing technology to build an IA HSI capability that includes the translation, formatting, distribution, and user access to digital audio information. It will leverage computer, communications, speech synthesis, and speech recognition technologies.

PHASE I: Develop a design for an IA HSI capability and build a prototype that demonstrates the basic system capabilities focusing on the user environment. This system should have an efficient and responsive method for: (1) translating text into audio formats, (2) electronically distributing information to users, and (3) giving users easy interactive access to audio information. The solution should address a full range of audio needs from speech to high fidelity as well as fixed and mobile environments.

PHASE II: Develop and test full IA HSI capability and demonstrate in an operational environment. This demonstration should include translation algorithms, audio formats, data compression techniques, communications interfaces, data storage, portable user access devices, and digital-to-audio interface.

PHASE III: Prepare 'plug and play' IA HSI capabilities for integration into Naval information systems.

COMMERCIAL POTENTIAL: This IA HSI capability could be used in the commercial environment to: 1) provide a quality of life for the visually impaired; 2) give commuters a safe interactive audio-oriented media to access information such as an audio version of the newspaper while driving an automobile; 3) improve control center responsiveness (e.g., air traffic centers, railroad/subway scheduling centers, port control center, emergency response); and 4) increase the efficiency of the business environment by giving people an option to interactively access documents in audio format while mobile.

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(1) Newman W.M. and Lannming M.G., "Interactive System Design," Addison-Wesley, 1995;
(2) Baber, C. and Noyes, J.M., "Interactive speech technology: Human factors issues in the application of speech input/output to computers," Taylor & Francis, 1993;
(3) Keller, E., "Fundamentals of speech synthesis and speech recognition: Basic concepts, state of the art, and future challenges," Wiley, 1994; (4) Sayood, K., "Introduction to data compression," Morgan Kaufmann Publishers,1996.

N97-152 TITLE: Wide Range Tunable Filter

OBJECTIVE: Develop, for shipboard applications, a bus controlled tunable filter with a tuning range of 2 MHz to 2GHz.

DESCRIPTION: Tunable bandpass filters are used in transmit and receive communications circuits to control shipboard EMI/EMC problems. They are used in transmit circuits to reduce out of band emissions that would otherwise block reception. They are used in receive circuits to prevent strong cosited transmit signals from overloading sensitive receive circuits. Currently there are different filters for each frequency band (e.g. HF, VHF, UHF). A single filter covering the 2 MHz to 2 GHz frequency band and usable as a postselector in transmit circuits or as a preselector in receive circuits would simplify the shipboard communications architecture.

PHASE I: Design a bus controlled tunable bandpass filter with a tuning range of 2 MHz to 2GHz.

PHASE II: Construct and test a prototype of the filter design.

PHASE III: Transition to Navy procurement of the filters.

This effort is critical for the RF power distribution areas of Slice radio since in an open architecture this device will be required to implement single RF power module into the system.

COMMERCIAL POTENTIAL: This filter would be usable in any communications system where transmitters are located in close proximity to receivers.

N97-153 TITLE: Security for Reprogrammable Electronic Devices

OBJECTIVE: Develop, validate and demonstrate a method or methods to provide security for reprogramable electronic devices, such as a transceiver capable of multi-band operation. The security system must also be multi-level secure (MLS) and be store and forward capable.

DESCRIPTION: Technology, both hardware and software, is making it possible to design and manufacture devices that can be reconfigured and be capable of performing multiple functions. Applying security to such devices presents a new problem while at the same time opening the window for technology to provide security solutions that are as advanced and innovative as are the devices they must secure. In addition to providing security to the device for every functional capability, there is a need to provide MLS and a need for a store and forward capability.

Security has traditionally been a black box solution. Although some elements of hardware may need to be employed, maximum use of software should be explored and the latest technologies in key management and smart cards evaluated. The solution to this problem will enable Navy planners and designers to make maximum use of multiple function reprogramable electronic devices.

PHASE I: Evaluate current equipment and programs for reprogramable electronic devices. Identify the security issues and challenges that this new electronic technology presents. Investigate the latest techniques in cryptology and key management that could be applied to the issues and challenges presented by reprogramable electronic devices. Propose an affordable concept for secure operation of these devices applicable for military and civilian use.

PHASE II: Demonstrate the proposed concept in hardware and software, preferably using NDI/COTS products in a Navy system.

PHASE III: Transition the security system for reprogramable devices into the commercial marketplace.

COMMERCIAL POTENTIAL: There are a number of commercial applications for security on reprogramable electronic devices such as the banking/financial industry and cable TV/consumer services industry.

REFERENCES: Copernicus...Forward, Naval C4I Implementation, SPAWAR, Arlington, VA 22245-5200.

N97-154 TITLE: Transmission of Critical Aircraft Flight/Emergency Data via JTIDS/MIDS (Lx Band)

OBJECTIVE: Provide real-time flight recorder data reports directly to aircraft control/monitoring sites or FAA/ATC flight centers. Real-time flight recorder and emergency data transmitted via LINK-16 can augment and expedite investigation agencies in reconstruction analysis.

DESCRIPTION: Communications and data processing have progressed to the point where it is now feasible to widely employ MIDS/JTIDS technology on commercial aircraft. By tapping the flight data information sent to the Flight Data Recorder (FDR) information can be transmitted it in real-time to air traffic monitoring sites. Data written to the flight data recorder could be digitally captured and transmitted using an exiting international and DoD message standard (TADIL J). The receiving site would then have aircraft position and FDR/cockpit information in real-time. In the event of a mishap or accident, rescue agencies would be able to quickly determine the precise location of the incident as well as make initial determinations as to the cause of the incident.

PHASE I: Conduct an analysis to determine the feasibility of identifying and gathering flight data recorder and possibly other appropriate flight information, for transmission in the standardized message format (TADIL J). Determine what, if any, changes would have to be made to current message standards or data rate in order to implement a standardized transmission of FDR information. Determine what subset of MIDS/JTIDS transmitter/receiver technology could be implemented in an affordable manner to make this commercially acceptable and still support the message structure and data rate needed.

PHASE II: Develop a flight qualified prototype to demonstrate the utility of broadcasting aircraft position and flight configuration in a crisis situation. Demonstrate that the data can be transferred via MIDS/JTIDS technology to a ground site.

PHASE III: Utilizing the concepts developed, modify commercial aircraft such that FDR type information is transmitted in real-time thus augmenting the current process of physically recover the FDR hardware.

COMMERCIAL POTENTIAL: This type of concept would allow the National Transportation Safety Board (NTSB) access to Flight Data Recorder information soon after an incident occurs. Allow for safety analysis to commence immediately upon an aircraft emergency occurring. Future extension into possible real time analysis by ground controllers for pilot alert on potential malfunctions.

N97-155 TITLE: High Energy Density Battery

OBJECTIVE: Develop a lithium/carbon monofluoride (CFx) battery by repackaging existing CFx technology into the geometry (cylindrical with center hole) needed for underwater applications. The inherent safety and high energy density of the CFx

electrochemistry will increase system safety and stability and provide 50% more operating lifetime compared with existing lithium/thionyl chloride batteries, without increasing weight and volume envelopes.

DESCRIPTION: Future underwater systems will be greatly limited by the size and weight of battery allocation. If properly packaged, existing lithium/CFx battery technology can provide 50% greater energy density, and therefore 50% increased mission lifetime, as compared with existing lithium/thionyl chloride batteries. Additional energy density improvements will be achieved by utilizing improved CFx materials as they emerge from ONR sponsored efforts currently underway. Improvements in CFx technology from other government funded efforts will be provided as GFE/GFI as they become available. Another CFx advantage is increased safety due to having a solid cathode material as compared to the liquid cathode of the thionyl chloride battery. Therefore there is less potential for the accidental emission of toxic liquid or vapor. Since CFx cells currently exist only as standard configurations up to the 'DD' size, this topic is focused on the development of large size lithium/CFx batteries in the geometry needed for underwater applications. Successful proposals will include demonstrated experience in fabrication of CFx cathode materials, fabrication of lithium anode materials, knowledge of CFx battery electrolyte and additive combinations, capability to design and fabricate CFx batteries up to 1000 ampere hours capacity, facilities and equipment necessary to accomplish prototype battery fabrication, and expertise of personnel.

PHASE I: Conduct a feasibility packaging study and design for the development of solid cathode CFx lithium battery cells in the size and geometry needed for future applications. Study variables shall include the possible effects of using innovative electrolytes, additives and electrode designs. Safety and environmental concerns shall be identified. The selected electrochemical system shall be assessed in small hermetically sealed cells. The study will be augmented by using the results of ONR work currently underway to develop new CFx cathode materials with increased voltage and capacity aimed at CFx cells in AA size for underwater mine batteries. All work will be documented in a final report.

PHASE II: Prototype large cells will be constructed and tested. Cell performance will be assessed in terms of improvement over existing lithium/thionyl chloride batteries.
A prototype battery will be designed based on the results of the prototype cell work. Reports will be issued at the Phase II midpoint and at Phase II completion.

PHASE III: A prototype battery sized for a selected mission such as ADS will be constructed and tested.

COMMERCIAL POTENTIAL: Lithium batteries in general have strong and growing commercial potential. Among primary lithium batteries, Li/CFx stands out with higher energy density, long shelf life and increased safety, and new low cost CFx materials will bring these advantages to a higher practical level. Smaller CFx cells will be useful in watches, portable calculators and medical implant applications (autoclavable). Larger cylindrical and rectangular CFx cells will be used in memory applications, radio sets, telemetry, photographic, satellite, oil well drilling, remote communications and general purpose applications.

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1. Handbook of batteries, second edition, D. Linden, ed., McGraw-Hill, NewYork 1995.
2. NSWC/CD Contract N00167-95-C-4014, Investigation and Development of Lithium/Carbon Monofluoride AA-size Cells, Rayovac Corporation, Madison, WI.

N97-156 TITLE: Application of Standard Network Technologies to Surveillance Arrays

OBJECTIVE: Developed techniques and system to eliminate or characterize standard network packet latencies. Incorporating networking technologies into multi-sensor distributed surveillance systems requires very accurate knowledge of the time associated with each data sample.

DESCRIPTION: Standard networking topologies provide well defined interfaces to work from, enabling greater interoperability between systems and provide a clear separation between the transport and application layers. While sufficient data throughputs are now commonly available, sampling coherency of multi-sensor distributed data continues to be a poorly addressed issue. Maintaining sampling rate clocks (1 to 10 micro-seconds) on widely separated data acquisition nodes using only network supplied protocols is an issue that has not been thoroughly addressed. It appears that connection oriented network topologies such as Asynchronous Transmission Mode (ATM) or ATM-Sonet provide the best mechanisms for maintaining coherent sampling throughput a distributed data acquisition system. There are, however, certain latencies within an ATM based system that may be variable. Techniques need to be developed to eliminate or characterize these latencies so that sensor networks with coherent processing between nodes requirements can be implemented.

PHASE I: Investigate the applicability of connection oriented network topologies such as ATM-Sonet for use in surveillance systems involving distributed acoustic and non-acoustic sensors. Develop a set of system requirements for a prototype system which includes a method of maintaining sample rate coherency, and demonstrate feasibility of the method. All work will be documented in a final report.

PHASE II: Fabricate and test a prototype multiple sensor node system based on the network topology selected. Design the prototype for a modular distributed application, and conduct testing to validate the full range of networking and coherency performance issues. Analyze test results and provide recommendations for full scale application to production surveillance systems. All work will be documented in a final report.

Phase III Develop build to print package for production of a surveillance system.

COMMERCIAL POTENTIAL: Many scientific and geo-exploration disciplines require coherent sampling in distributed data acquisition systems. Developing coherent network based topologies would open up entirely new possibilities for data processing in the seismic and oil exploration industries

REFERENCES:

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2. Mark Rockwell, "Project ATM Network Provides Proving Ground", Communications Week, Nov. 27, 1995, p.5, http://techweb.cmp.com/techweb/programs/
3. MONET Testbed, http://fury.nosc.mil
4. John Rendleman, "Sun and Surf Over ATM", Communications Week, Dec. 18, 1995, p.21
5. Wesley Kaplow, "The Role of ATM in Unifying C^4I Networks", U.S.N. Next Generation Computer Resources Conference, Sept. 20, 1995, Washington D.C. http://ngcr.nwscc.sea06.navy.mil/agenda.htm
6. Pat Haleftiras, "ATM Navy Tactical Applications", U.S.N. Next Generation Computer Resources Conference, Sept. 21, 1995, Washington D.C. http://ngcr.nwscc.sea06.navy.mil/agenda.htm
7. John Walrod, "ATM Telemetry Systems for Sensor Arrays", U.S.N. Next Generation Computer Resources Conference, Sept. 21, 1995, Washington D.C. http://ngcr.nwscc.sea06.navy.mil/present/walrod.ppt

N97-157 TITLE: Code Analysis Tools for High Integrity Systems

OBJECTIVE: Develop code analysis tools to support the analysis of safety-critical, mission-critical systems.

DESCRIPTION: Ada 95 is an excellent language for the development of high integrity systems with safety-critical and mission-critical requirements. Specific guidance in the use of Ada 95 for the development of safety critical, mission-critical, and secure software is evolving through organizations such as the Safety and Security Rapporteur Group (ISO/IEC JTC 1/SC22 WG9/HRG). Their current work is leveraging a Canadian study addressing Ada95 Trustworthiness. Technologies are emerging to support the code analysis of such systems. Interfaces such as the Ada Semantic Interface Specification (ASIS) provide access to useful semantic and syntactic information available in the Ada 95 compilation environment. This SBIR concerns the development of a tool to assess source code for the analysis of its safety-critical and mission-critical properties.

PHASE I: Develop the design for a code analysis tool using ASIS to automatically analyze high integrity code based on guidelines derived from the HRG. [Those guidelines not practical for automatic analysis should be identified]. A design suitable for tool implementation will be produced. A draft user's guide for the tool use will be produced.

PHASE II: Develop the tool. This tool will be portable across all major Ada environments having an ASIS implementation. Successful completion of this phase will require demonstration of this tool on a large sample of SPAWAR provided Ada 95 code (approximately 500K). A final user's guide for the tool will be developed. Portions of the tool not commercialized will be placed in the public domain.

PHASE III: Support code analysis of SPAWAR programs.

COMMERCIAL POTENTIAL: Code analysis for Safety-critical and mission-critical properties is needed in many governmental organizations to include the DoD, NASA, DOT, DOE, and NRC. There are also significant needs in industry for such domains as avionics, ground transportation, medical, and process control.

REFERENCES:

1. Ada95 Trustworthiness Study: Guidance in the Use of Ada95 in the Development of High Integrity Systems; 12 September 1996; Canadian Department of National Defence, Chief of Research and Development, TR-96-5499-04.
2. ASIS Home Page: http://www.acm.org/sigada/WG/asiswg
3. HRG Home Page: http://www.npl.co.uk/npl/cise/systems/hrg.html

N97-158 TITLE: Detection using a Generalized Hough Transform Track- Before- Detect Processing of Split Horizontal Line Array Cross-Correlations

OBJECTIVE: The objective of this proposal is to provide a system capability to automate the detection, localization, and tracking of targets in shallow water scenarios characterized by many relatively short-range targets producing highly dynamic

bearing measurements using extraction of bearing versus time information from split aperture horizontal line array cross correlations (Correlograms).

DESCRIPTION: Surveillance or tactical shallow water acoustic sensor system scenarios can be characterized by many relatively short-range targets producing highly dynamic bearing measurements. Under these conditions, significant temporal integration gain in the 2-dimensional bearing-time space can be achieved only by hypothesizing target motion through a 2-dimensional bearing-time space. Automating the detection, localization, and tracking of tracks targets in correlograms can be achieved through Track-Before-Detect processing of correlograms. In Track-Before-Detect processing, many possible tracks are hypothesized. Each hypothesized (constant velocity) tracks is defined by a set of track motion parameters, which assumes for a contract a constant course and speed over a given period of time. This contact motion description for example will fit into the framework of a generalized Hough Transform. In the underwater acoustic sensor context, the 2-dimensional input image is a finite duration time segment of the bearing-time space. Offers should show previous applicable experience in ocean propagation modeling that includes signals interacting with the bottom, and in underwater signal processing. An initial or example set of algorithms will be supplied GFI in an NRAD Technical Report if desired.

PHASE I: Development and implement the required algorithms on sample acoustic sea test data provided GFI by the ADS/AODS Program. Demonstrations will be performed on contractor's workstation with results, evaluations of performance, and algorithmic descriptions documented in a final report. Beamforming algorithms provided GFI.

PHASE II: Integrate and demonstrate tracking algorithms and system on a Navy parallel processor (NRaD's or NRL's) Using GFI multi-node data sets provided by ADS/AODS and FDS Programs. Beamforming algorithms provided GFI. Demonstrate a tracking process which clusters detections from individual data segments, and then fuses or links the detections across multiple data segments. A requirement of this tracking process is to obtain accurate and consistent contact tracks across beams and array nodes. A Final report will document work, evaluations of performance, and descriptions of all algorithms.

PHASE III: Provide the technical data and support to the Track-Before-Detect processing as a technology insertion into the ADS Program.

COMMERCIAL POTENTIAL: The technology development in this project could be applied to any image processing/detection problem where the object of detection in the image can be analytically represented. Applications may be found in image analysis problems from in undersea surveillance, the medical, geophysics, satellite, space, and radar fields. The final product could be sold to military prime contractors in the field of undersea surveillance.

REFERENCE:

1. Ballard, D.H., "Generalizing the Hough Transform to dectect arbitrary shapes", Pattern Recognition 13(2), pp 111-122, 1981.
2. Sevens and Shy, Application of the Hough Transform to Acoustic Broadband Correlograms for Passive Detection and Location, NRL/MR/5580-92-7182, January 7, 1993.
3. Brannan, R, NRaD TR#xxxx Technical Report, in preparation.

N97-159 TITLE: Generic Multiple Access Module Prototype for the PRIDE (Programmable Intelligent Digital Electronics) System

OBJECTIVE: Develop a prototype multiple access module which can be integrated into a PRIDE system.

BACKGROUND: A PRIDE system consists of a multifunctional hardware engine, middleware and application software modules. It accommodates many different Navy missions and operational scenarios. As a communications engine, it can be viewed as a chameleon radio performing the radio function needed at the time.

DESCRIPTION: A prototype module is to be developed that is able to model, analyze and control multiple access resource allocation algorithms implemented in a real-time fashion. It should make use of existing analytical methods and tools for the modeling and analysis of the underlying multiple access and switched network systems. The prototype must be integrated into the PRIDE system structure, interacting continuously with other system modules, serving to adaptively control the sharing of the available communications resources among the involved multi-media message streams. The module will be used to dynamically regulate the access of message flows from the PRIDE unit to the network using current status information and assign each active traffic stream its appropriate channel and access slots. In doing so, the module must integrate status information obtained from other PRIDE modules and from external signaling ports. Real-time and non-real-time applications must be supported so that each is guaranteed acceptable throughput, delay and delay jitter performance levels, on a priority basis.

PHASE I: Review the structure and modules implemented by a PRIDE system, as well as the underlying applications, traffic processes and link/network systems and services. Characterize the underlying interfaces with other PRIDE modules and with signaling ports. Develop the architecture, key approaches, models and analysis methods to be implemented in Phase II. Demonstrate the feasibility of the design by considering a Navy automated digital network system as a test case.

PHASE II: Develop the underlying access control and networking algorithms.

Develop the associated analysis, synthesis and control procedures. Develop the computer software for the tool prototype. An easy to use graphical user interface should be employed. Demonstrate the tool's functions in a laboratory environment.

PHASE III: Anticipated future use in Navy shipboard and on-shore networks.

COMMERCIAL POTENTIAL: Commercial applications to packet radio networks, satellite networks, integrated terrestrial and satellite radio and wireline networks; wireless local and metropolitan area networks.

REFERENCE: JMCOMS Master Plan, SPAWAR; Copernicus...Forward, Naval C4I Implementation, SPAWAR, Arlington, VA 22245-5200.

N97-160 TITLE: Broadband Signature Information Identification and Extraction

OBJECTIVE: Identify and develop classification techniques based on passive broadband and wide band signal parameters.

DESCRIPTION: Many projected passive systems will use either broadband power detection or cross sensor correlation for detection and tracking. There has been indication that there are clues available in the information provided by such systems, that can provide target identification and a automatic target monitoring capability. There exists a need to explore this possibility in greater detail. In a cross correlation system some information on the signal-plus-noise correlation function is available. Multipath structure affects broadband signal with differing spectra in different ways, and these differences may offer information. Techniques are required which exploit available broadband clues to provide classification information.

PHASE I: Develop algorithms useful in extraction of braodband and wide band signature component clues and evaluated their effectiveness using real GFI sea test data. A data examination of passive acoustic broadband and wide band (1 Hz. to Several Hz.) signatures of various contacts including submarine will also be conducted to identify useful broadband correlation and wide band clues. All work will be documented in a final report.

PHASE II: Selected algorithms will be extensively investigated using real sea data (GFI) for regions with known shipping, i.e., known ships' identities and known ships' tracks, to evaluate system effectiveness under realistic operating conditions and environments. All work will be documented in a final report.

PHASE III: Successful algorithms shall be integrated into selected, evolving passive sonar systems such as SURTASS, ADS, etc.

COMMERCIAL POTENTIAL: The technology for providing solutions to this topic can also be useful in commercial applications such as remote machinery condition monitoring, radio astronomy, and volcano eruption /seismic activity prediction.

REFERENCES: McDonough, R.N., and Whalen, A.D. Detection of Signals in Noise. Academic Press, 1995.

N97-161 TITLE: Shipboard Auto-Tracking with a Stabilized Platform

OBJECTIVE: Develop a low cost, compact, stabilized platform system to correct for ship and target motion by integrating existing gimbals, servos, and software to support a 250 lbs electro-optical sensor.

DESCRIPTION: Missiles flying close to the surface of the ocean can be detected and closed-loop tracked using a passive electro-optical (E/O) sensor. Tracking of maneuverable targets is severely hampered by target motion, particularly in a low contrast and high clutter environment. Additionally, compensation for platform motion in any sea state compounds the shipboard tracking challenge. The tracking issues are made even more difficult when high resolution sensors with very narrow optical fields-of-view are used. The stabilized platform system must allow for hand-over from the ship's radar and be capable of auto-tracking the target with an E/O sensor once an operator designates a target. The tracking system must be capable of performing in a centroid or an edge tracking mode. This should be accomplished in a low contrast or cluttered environment. This program should lead to the demonstration of this enhanced imaging system at sea.

PHASE I: Show technical feasibility of a gimbaled platform with an E/O sensor capable of rejecting ship's motion, vibration, and flexure while centeroid or edge tracking in a sea state three. The concept should use modern technology and existing components (where possible) to minimize cost.

PHASE II: Develop and demonstrate the stabilized shipboard tracking system as described above.

PHASE III: Develop a plan for production and demonstrate a cost effective manufacturing approach.

COMMERCIAL APPLICATIONS: Once developed, this system could be used by law enforcement officials, Coast Guard, NASA, and others with commercial remote sensing applications.

N97-162 TITLE: Physics-Based Signal Processing Techniques For Next Generation Naval Systems

OBJECTIVE: Develop novel signal processing and beamformer techniques for next generation naval systems which utilize available information about the physical environment for robust detection, localization, and classification.

DESCRIPTION: Currently deployed Navy sonar systems use signal processing and beamformer techniques which effectively treat the underwater acoustic environment as a homogeneous medium. Only limited use of advanced modeling techniques such as AR and ARMA have been employed, and even these models cannot accurately model the true physical nature of the ocean. At the rate of maturation of current systems, which has been accelerated by leaps in low cost processing power, their basic signal processing paradigms will limit future improvements in performance, ultimately resulting in a performance ceiling for such systems. Next generation systems, if they are to offer substantial performance improvements, must account for the true physics of underwater acoustics. Techniques which fully utilize propagation models and physical environmental information, have demonstrated promising results but require comprehensive information and suffer severely when information is even slightly inaccurate. Thus, robust signal processing techniques which can take advantage of available environmental information are sought for next generation naval systems.

PHASE I: Develop a robust signal processing system including beamforming which accounts for ocean physics and demonstrate potential improvement over existing systems by developing and integrating a three-dimensional broadband shallow-water ambient noise model (from 10 Hz to 10,000 Hz.) which utilizes 3-D bathymetric and geophysical description of the propagation medium as inputs. ADS/AODS array node element data with bathymetric and geophysical data will be provided GFI. All work will be documented in a final report.

PHASE II: Implement a prototype on a Navy parallel computer (NRaD's or NRL's) and quantify and evaluate performance with archived GFI sea-test data. All work will be documented in a final report.

PHASE III: Provide technical expertise and support for technology insertion of a prototype system into a complete shipboard system for extensive at-sea testing.

COMMERCIAL POTENTIAL: Physics-based signal processing techniques can be applied to a number of industries that are challenged by complex physical phenomena. Examples of such include the cellular telephone industry, which must manage complex propagation of radio waves in cities, medical imaging and the propagation effects of acoustic and EM waves through tissues, and environmental science where dispersion of contaminants and/or organisms in land, air, and sea follow complex physical laws.

REFERENCES:

1. Krolik, J.L., ÒMatched Field Minimum Variance Beamforming in a Random Ocean ChannelÓ,J. Acoust. Soc. Amer., (92), 1408-1419, 1992.

2. Porter, M.B., et al., "Simulations of Matched Field Processing in a Deep Water Pacific Environment", J. Acoust. Soc. Amer. (89) May 1991.

3. M. D. Collins and S. A. Chin-Bing, "A Three-Dimensional Parabolic Equation Model that Includes the Effects of Rough Boundaries," J. Acoust. Soc. Am. 87, 1104-1109 (1990). [This paper contains the first 3-D PE solutions that exhibit azimuthal coupling]

4. M. D. Collins, "The Adiabatic Mode Parabolic Equation," J. Acoust. Soc. Am. 94, 2269-2278 (1993). [This paper combines normal mode and PE techniques to obtain solutions efficiently]

5. G. J. Orris and M. D. Collins, "The Spectral Parabolic Equation and Three-Dimensional Back Scattering," J. Acoust. Soc. Am. 96, 1725-1731 (1994).[This paper solves a special class of 3-D problems that are useful for benchmarking]

6. M. D. Collins, B. E. McDonald, K. D. Heaney, and W. A. Kuperman, "Three-Dimensional Effects in Global Acoustics," J. Acoust. Soc. Am. 97, 1567-1575 (1995). [This paper shows that the approach of Ref. 2 can be applied to large-scale problems]

7. M. D. Collins, B. E. McDonald, W. A. Kuperman, and W. L. Siegmann, "Jovian Acoustics and Comet Shoemaker-Levy 9," J. Acoust. Soc. Am. 97, 2147-2158 (1995). [An application of the approach of Ref. 2 generalized to account for fluid flow]

8. M. D. Collins, B. E. McDonald, W. A. Kuperman, and W. L. Siegmann, "Horizontal Refraction of Gravity Waves by the Jovian Zonal Winds," Wave Motion (submitted). [Related to Ref. 5 but for internal gravity waves]

9. A. T. Abawi, W. A. Kuperman, and M. D. Collins, "The Coupled Mode Parabolic Equation," J. Acoust. Soc. Am. (in preparation). [Generalizes the approach of Ref.2 to include mode coupling]

N97-163 TITLE: High Performance Elastrometric Boot materials for Advanced Low Frequency Sonar Projector Applications

OBJECTIVE: The objective of this topic is to develop and evaluate state-of-the-art elastomeric boot materials for use with advanced high power low frequency sonar projector designs. New and innovative projector boot materials are required that have higher strength, and are more reliable, durable and last longer in a severe underwater environment.

DESCRIPTION: The next generation low frequency sonar projectors will require elastomeric boot materials with improved performance characteristics. New and innovative elastomeric resin systems and reinforcements are required which can withstand the mechanical and thermal loads imposed by these more compact, higher powered projector designs, while maintaining or improving the acoustic performance of the current boot materials. Cost effective elastomeric boot material formulations are desired that can be readily mass produced for high volume production. The ideal good material will provide a reliable, leak free barrier in a sea water environment for the service life of the projector. The boot material must withstand the stresses from active transmission, and varying hydrostatic pressure due to deployment and retrieval, over the life of the projector.

PHASE I: Define the material requirements for the next generation low frequency sonar projector boot designs. Prepare sample quantities of proposed boot material(s) for testing. Perform initial material testing and comparative evaluations on proposed boot material(s) and currently used boot materials. Optimize the proposed boot material formulation(s) for improved mechanical performance, acoustic performance, cost effectiveness and reliability. Define requirements for accelerated life environmental testing of proposed boot material(s). Prepare final report.

PHASE II: Perform extensive mechanical, acoustic and accelerated life environmental testing on candidate boot materials. Design and fabricate test article boots from candidate materials for installation on prototype next generation low frequency sonar projectors. Perform laboratory tests on the boot material for survivability in sea water, cycle test for life in high intensity acoustic fields (greater than ten million cycles), and for required acoustic and mechanical properties. Prepare final report.

PHASE III: Perform high volume production fabrication and cost analyses, and monitor production contract in support of low frequency projectors.

COMMERCIAL POTENTIAL: New and innovative projector boot materials and manufacturing technologies developed during this effort will have extensive commercial applications in the construction, oil and gas, and automotive industries.

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3. Duffe, J.V. et al (Polymer Phsics Group Naval Surface Warfare Center), "Dynamic Mechanical Properties of Poly(tetramethylene ether) Glycol Polyurethanes," and other papers in Am. Chem. Soc. Publ. Sound and Vibration Damping with Polymers, R.D. Corsaro and L.H.Sperling eds., 1990.

N97-164 TITLE: Reengineering of Distributed Source Code

OBJECTIVE: Reengineer the specification or design from the existing source code for a large distributed application.

DESCRIPTION: Methods and tools have emerged to reengineer specifications and designs from existing source code. There is a need to address reengineering for a large distributed application to facilitate program maintenance activities and evolve portions of the distributed system. This would make possible the redistribution of functionality within a legacy environment enabling the evolution of selected components with minor upgrades to other components.

PHASE I: Demonstrate the capability to evolve new code from existing code, such as the Space and Naval Warfare System Command's (SPAWAR) Integrated Undersea Surveillance System (IUSS). IUSS consists of approximately 3.6 Million Software Lines of Code (SLOC), including Ada 83, C, and assembler. Evolution capabilities to Ada 95 and C++ would be required. The demonstration will require close coordination and training with SPAWAR personnel and their contractors. A report would be required.

PHASE II: Provide extensions and modifications to use the program output in rehosting tools, such as the Rapid Application Specific Prototype Single Processor (RASSP) and RIPPEN . Address issues associated with integrating new specifications from new requirements to the reengineered specifications from this tool. In particular, tool-generated specifications should agree with specifications used to automatically generate code from other tools. Mechanisms to reconcile differences should be provided. This capability should be demonstrated on at least one SPAWAR evolving program working closely with SPAWAR personnel and their contractors.

PHASE III: Support rehosting of programs such as the Advanced Deployment System (ADS) prototype to production.

COMMERCIAL POTENTIAL: There is much distributed legacy code that requires reengineering in the DOD, government, and commercial industry (e.g., banking).